# GAS JOURNAL

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## A CRACK WITH THE ENGINEER

COMMENTING on Mr. Herbert's paper—see later pages—is like talking over old times with a friend. He has been long associated with one of the great gas undertakings whose reputation for solid, substantial engineering construction stands very high. A hundred years ago it was mainly civil engineering, but when it took to mechanisation it brought to it the same standards of stability and permanence.

Mechanisation came to the gas industry seventy or eighty years ago—at about the same time as to other industries. Its first task was to relieve the manual worker in the arduous labour of charging and discharging the horizontal retort. Machines for this purpose were worked out by one or two men who were either gas engineers themselves or closely associated with the industry. They soon detached themselves from gas manufacture and established the great firms of contractors who serve the industry today And before we plunge into the detail of Mr. Herbert's paper we must dispose of the one paragraph in which he appears to permit himself a 'crack at the contractor' The fact is that not only is the contractor—we are speaking of those really 'in' the gas industry—'able to accumulate . . . . experience of the working of plants over long periods of time,' but it is his constant care to collate experience of the working of many plants while the gas engineer and his staff is often confined to experiences in the one or two works with which they have been associated. Of course, there is no quarrel about it. One of the outstanding features of the gas industry is the constant and cordial co-operation between the two sides. Usually the design of a gasworks installation is a fruitful collaboration between the contractor and the gasworks engineer, the former contributing his wide experience in plant applied to many problems at home and abroad, the latter his intensive experience of plant in use and the intimate knowledge of his own requirements.

It was inevitable that the treatment of such a subject as this should present the appearance of a long list of details, and equally inevitable that the list should prove to be far from exhaustive. What general principles are discernible are pointed out by Mr. Herbert. Gasworks plant must generally be designed for continuous operation, without a break by night or day and without a day's rest in the year. It must stand up to corrosion and abrasion. Standby plant and a general provision of spare parts against occasional breakdown must be the rule. with very few exceptions. Designers of electrical plant and equipment in particular have been forced into a substantial construction and a complete enclosure of their motors, switches, and other apparatus of a stringency not required by any of the other industries which they serve. The gasworks motor has become a regular and well-understood technical term.

Cast iron renders a very necessary, an almost indispensable, material in many forms of gasworks construction The Cast Iron Research Association, of which most gasworks constructional engineers are, and all should be, members, has done much to standardise the composition of this somewhat elusive material—much to introduce heat and corrosion resisting mixtures. It is a pity that some of these are still kept as trade secrets, partaking too much of the nature of patent medicines. Heat-resisting steels are also of great, if somewhat potential, interest to the gas engineer. Who has not dreamed of an absolutely gas-tight alloy steel retort? Such steels will be required in any further attempt at the realisation of a metallic recuperator. The problem here is to find a metallic tube which will stand up to 1,000°C. in an atmosphere of sulphur-rich gases. The nearest approach to success in this is said to be achieved by an alloy-steel known as 'Sicromal,' the name indicating an alloy of steel with silicon, chromium, and aluminium.

Mr. Herbert calls attention to the great care which must be exercised in the use of mild steel—so particularly vulnerable to corrosion. One wonders whether he has heard of a simple rule observed in a well-known drawing office in the selection of rolled sections for such light structures as roof principals. It is based on the observation that pitting caused by atmospheric corrosion in the gasworks may go as deep as, but generally not deeper than, $\frac{1}{8}$ in. in a satisfactory working life. The designer, therefore, selects the section called for by his stress diagram and then adds this $\frac{1}{8}$ in. to it to allow for corrosion, with a minimum of, say, $\frac{3}{8}$ in. for all members.

Alloy steels are coming rapidly into use for the details

mentioned by Mr. Herbert. Accelerated by the requirements of war weapons the number of alloy steels not available is very great. But in gas engineering proper their application is limited. To take an older example, it might be thought that the use of high-tension steel—*i.e.*, 40/45 ton as against 28/32, would effect a substantial saving in the heavier conveyor driving shafts by reducing the weight of steel required, the size of bearings, bosses of wheels and so on; but actually these advantages are just about balanced by the greater cost per unit weight of the special steel. Nevertheless, there are cases where saving in bulk and space occupied turns the scale. Aluminium used alone needs care. There was a retort house roof in a seaside town where the slates were attached to steel purlins, always something of a problem, by aluminium wire—very nice and convenient to handle and when new a very satisfactory job. Within a comparatively few months it had corroded away in the salty seaside air to such an extent that the slates began to fall and the aluminium wires were replaced by ordinary steel hook bolts. Under other conditions the aluminium wire lasted well.

## NEW MATERIALS

PLASTICS have been used for small details, but transparent plastics, *e.g.*, 'Perspex,' may find a wider use. Corrugated perspex sheets made to the same design as corrugated iron have been used for roof and wall lighting. Here we may interpolate an instance where glass bricks have been used for wall lighting. In both cases special frames are dispensed with. The success of the rubber belt in conveyors, particularly in handling coke still hot from the quenching bench, is remarkable. One wonders whether one or other of the new synthetic heat- and acid-resisting rubbers would not give even better results.

In view of the many attempts to substitute something for the orthodox brick construction in buildings, it is interesting to note that Mr. Herbert has found them disappointing, in which most engineers of experience will agree with him. Concrete construction is probably entering a new phase of development. The techniques of pre-stressing and vibrating are giving this material greater unit strength and enhancing its reliability. Quick-setting and acid-resisting cements are increasing the range of its application. In foundation work it has long reigned supreme, but bunkers and buildings above ground have often been somewhat disappointing in appearance, easily disfigured by the elements, liable to cracks and other damage, due to expansion which it is not easy to allow for.

The section on mechanical handling equipment is particularly interesting. Conveying and elevating systems are frequently the life-line upon which the production of gas depends. The belt conveyor is singled out as a particularly reliable machine. In spite of its limitation to an inclination of not much more than 18° to the horizontal it should be adopted wherever possible in gasworks layout, especially for the transport of coke, a material which it handles with less damage either to the coke or to itself than any other machine. Mr. Herbert's liking for the vertical belt-bucket elevator is interesting. For the handling of coal, oxide, and similar materials it has all the virtues he claims, but it needs careful feed and its discharge by centrifugal force renders it quite unsuitable for coke; indeed there is no form of fixed bucket elevator which is satisfactory for the handling of this difficult material.

The gravity-bucket conveyor—now generally with lipped buckets in spite of the slight disadvantage mentioned—remains the best means of elevating within a short horizontal distance and it is sufficiently continuous for all practical purposes. The lubrication problem has been completely solved the automatic oiler generally fitted, and provided this conveyor receives adequate attention, and the tracks are kept in line, it is an entirely satisfactory machine for the handling of coal, but wear and tear become heavy when coke it carried. With this material, and to some extent with coal, the corrosion of the buckets may be rapid. Several attempts have been made to counter this. Buckets have been lined with vitreous enamel, they have been made in aluminium sheet, both with some success, but perhaps at a cost not altogether justified by increased life. The use of copper-bearing steel seems to give the greatest all-round satisfaction.

## LUBRICATION

GASWORKS plant presents unusual problems to the mechanical engineer. Conveyor driving shafts, for instance, may be required to transmit as much as 25 H.P. at three to four revolutions per minute under considerable bending loads. Not only are these shafts very large, but the load on their bearings is very great. At speeds so slow ball or roller bearings do not give their best results and there is really nothing better than a plain bearing with gun-metal steps of ample area with pressure grease lubrication. Everyone will agree with Mr. Herbert's warning on the troubles likely to arise in the too-great elaboration of centralised batteries of oil or grease lubrication with long runs of tubing. These should extend no further than is necessary for safety reasons. A provision which is well worth making in the permanent structure is that of a substantial member, adequately supported in the main structure, to which lifting gear can be readily anchored for the handling of heavy shafts with their gearing as may be required for maintenance purposes. The rigging up of make-shift means for this purpose may lead to considerable loss of time and money as well as to such inconvenience in attention to worn parts as may lead to the work being done at something less than the highest standard.

The provision of replacement parts for all details liable to wear is recognised as an important part of the duties of the gasworks engineer and his storekeeper. The contractor usually supplies drawings specially made to show how the apparatus is to be operated and particularly indicating with reference numbers those parts which should be kept in stock or which may required to be supplied at short notice. It is good practice to keep these drawings in an easily accessible place; in some cases they may be framed and hung in the vicinity of the plant to which they refer.

It was not to be expected that Mr. Herbert's notes

or those of any other engineer would be exhaustive, but we are sure that his colleagues will be grateful to him not only for an interesting gossip on subjects in which they are keenly interested, but for his valuable addition to the general corpus of practice in gasworks constructional engineering.

## TACTICS AND ECONOMY

THE further discussion of Mr. Hawthorn's important paper has turned on tactics rather than strategy, upon the manipulation of plant in detail rather than its disposition to deal with long-term problems, and mostly, as is right and proper, with that of the carbonising and other gas-making plant. The argument seems to turn on the dictum that fundamentally increase in throughput will mean increase in the output from the plant. But what are the 'fundamentals'? Even in horizontal retorts the quantity of coal which can be carbonised in a given time is conditioned by the heat put into the setting and by the temperatures carried in the combustion chambers. Perhaps we slipped up a little here. We thought that Mr. Hawthorn was starting with plant already adjusted correctly, so that it was burning off its charge and making gas of the desired quality. These factors are not so readily adjusted in the horizontal as in the vertical, particularly the continuous vertical, retort. Here, throughput —that is, the speed of extraction—is bound up with several other factors the alteration of any one of which will have its effect on the others.

Evidently there was some confusion among the speakers and writers on this subject. In the first place the design of the heating arrangements for a continuous vertical will be different if you want to make gas at the highest possible calorific value with a given coal. Steam serves (mainly) two purposes, to a certain extent both at the same time. It serves to cool the outgoing coke (and to keep the bottom ironwork from becoming over-heated) and to make water gas *in situ*. The first of these purposes can be attained by external cooling of the retorts by circulating incoming secondary air round their bases. It has been proposed by Dr. Pexton to circulate primary producer air also round the retort bases. This has not yet, to our knowledge, been done, but with secondary air circulation a certain amount of steaming is also necessary. With the throughput stretched to the maximum the minimum proportion of steam for safety was found at the Fuel Research Station to be something like 5% by weight of coal throughput. This steam will generate a certain amount of water gas *in situ*. The maximum possible calorific value of the mixed gas would be governed entirely by the properties of the coal. It could, therefore, be adjusted to any desired lower value by increasing the proportion of steam to charge but, at the same time, and inseparably from it, the throughput would have to be reduced unless it were possible to increase the temperatures in the combustion chambers. The point is that throughput, setting temperatures and steam vary inseparably if the plant is properly adjusted. No one of these variables is more fundamental than the others.

In practice, surely, it is a question of making gas at a definite calorific value. For nearly every coal, if this value is at or below 500 B.Th.U., steaming will have to be above the minimum needed to keep the ironwork cool and to recover the waste heat of the coke. At the lower values it may be necessary to dispense with secondary air circulation altogether. But that is by the way. The fact is that if the plant is correctly adjusted it will be working with the only possible throughput to give gas of the fixed calorific value. Of course, this is too rigid a statement and the throughput can be varied a little either side of the optimum value. But the cheapest therm will be produced when the water gas made *in situ* is as near to the theoretical $CO/H_2$ mixture as possible (conveniently indicated by a calorific value not less than, say, 300 B.Th.U.) and when the maximum thermal output per retort is obtained; in other words when the maximum therms per retort is combined with the maximum therms per ton at the predetermined calorific value.

## COMPLEX ACTION OF STEAM

THIS argument is too simple because the action of the steam in the continuous vertical retort is more complex than just the formation of water gas with the coke. The hot gas formed at the base of the retort, and the unconverted steam, rise in the retort and effect a certain amount of internal heating. These reactions had already been analysed to some extent in the report on the tests of 1920-21 at the Fuel Research Station, but no one has yet succeeded in evaluating or predicting them. It follows that while it might be said with some approximation to the truth that it is well for the steaming of intermittent verticals—which takes place after carbonisation is complete—not to exceed the capacity provided by the sensible heat of the coke, this would not be a safe principle in the steaming of the continuous vertical retort. Clearly, too, even in the intermittent retort, it would be well to define more closely the term sensible heat—to what lower limit of temperature, for instance. In the continuous retort one can distinguish several stages, the superheating of the steam rising in counterflow with the coke, the water gas reaction over a certain range of temperature, the internal heating effect of the hot gas and unconverted steam in the upper part of the retort. And there is an evil indeed—the loss of heat from the system carried away by the unconverted steam. A certain amount of this appears to be unavoidable but it should never be made worse than need be by what is known in the retort-house as over-steaming. Perhaps this is what Mr. Firth has in mind.

We then come to the choice of the optimum calorific value at which to operate the plant with the coals available. With the statements on this point in the original paper we fully agree: 'A continuous vertical retort should only be called upon to produce a certain limited quantity of blue water gas by steaming. Steaming beyond the optimum point reduces the therms produced per retort per day.' We have already expressed our view that for any given coal and for any given retort there is, no doubt, a particular calorific value at which the cheapest therm can be made. We have further stated that this optimum point has never yet been determined and that it might well be worth while to spend the necessary money and time on investigations to establish it, at least in one or

two cases. But, in the meantime experience has shown that for each of the main divisions of gas-making coals there is a certain range of calorific value over which the output of therms per retort can be kept constant while making gas with 'added gas' of satisfactory water gas quality. Experience has also shown that mixed gas can be made in the one operation with generally less but certainly not more expenditure of coal than when the added gas is made in external plant. And the reason is not far to seek. The additional gas is made with an expenditure of not more than 15 lb. of coke per 1,000 cu.ft. of added gas—a figure which leaves a comfortable margin for the additional fuel required in the producers to make up for the loss of heat in the setting after the sensible heat in the discharged coke is exhausted. One set of calculations we have seen shows that, comparing the production from Yorkshire coals of a gas at 500 B.Th.U. with that at 450, an additional 5,000 cu.ft. of gas was made with a reduction of 130 lb. of coke available for sale per ton of coal carbonised. The overall thermal efficiency was slightly higher at the lower calorific value.

## LONG-TERM POLICY

THIS is, of course, no argument for making 450 gas with Yorkshire coals in all circumstances, but it does show that such a practice is attended with no particular evils. Indeed, in a time of coal shortage we should like to know what arguments can be brought against the case for making the maximum number of gaseous therms per ton, at whatever calorific value, consistent with the maintenance of a good thermal output per retort.

Which brings us to the next point, about which no one seems inclined to argue, that the gas industry must base its grand strategy, its long term policy, on producing the maximum number of useful therms—therms, that is, after allowing for efficiency in use (whether in gas or coke) which can be delivered to the consumer per ton of coal used in the process as a whole. We are repeating ourselves. But just to give it concrete shape, if we take the same calculations we find that, making gas at 500 we make 78 therms of gas per ton, which utilised with 50% efficiency is 39 useful therms, and 153 therms of coke less loss in breeze, &c., say, 10%, equals 138 therms which utilised at 25% efficiency is 34.5 useful therms, a total of 73.5 useful therms. At 450 the figures would be 93 therms of gas equal to 46.5 useful therms, plus 123 therms (136, less 10%) of coke, equal to 30.7 useful therms, a total of 87.2—an increase of practically 12%. The figures are rough, but if something like that can be achieved without reducing therms per retort, which roughly is the measure of labour plus capital cost per therm ex retort-house, what is to be said against a policy in that direction?

The question of benzole extraction is a more vexed one. It was well argued, but on the whole we think that Mr. Hawthorn's case stands. At any rate it sounds a little odd to take out benzole only to add petrol for enrichment. Benzole extraction as well as the choice of calorific value will be affected in the short run by the price of coke. One might well ask why the price of coke for sale is fixed at its present high figure while one hears complaints on all sides of the unsaleability of coke If the price were left to find its free level, which would be well below that of household coal, some of the arguments might have to be revised.

# Diary

**April 14.—Institution of Chemical Engineers:** 28th Annual Corporate Meeting, May Fair Hotel, Berkeley Street, London, W.1, 11 a.m. Annual Dinner, Ball Room, 7 for 7.30 p.m.

**April 14.—London and Southern Junior Gas Association:** 'The Application of Electrical Equipment in the Manufacture and Distribution of Gas,' H. F. Buxton, B.SC., 178/180, Edgware Road, W.2, 7.p.m.

**April 14.—Scottish Junior Gas Association (Western District):** Annual General Meeting. Royal Technical College, Glasgow, 5.30 p.m.

**April 18.—Midland Junior Gas Association:** Annual General Meeting. Birmingham.

**April 19.—Manchester District Junior Association of Gas Engineers:** Joint Meeting with Yorkshire Junior Gas Association. Visit to Clayton Son & Co., Ltd., Leeds. Papers, 'The Design, Construction, and Maintenance of Gasholders of all Types.'

**April 20.—Midland Association of Gas Engineers and Managers:** Luncheon, 12.45 p.m.; Annual General Meeting, 2.30 p.m. Queen's Hotel, Birmingham.

**April 20.—Scottish Junior Gas Association (Western District):** Evening Visit to Mossend Works, Fertiliser Section, Imperial Chemical Industries, Ltd.

**April 21.—London and Southern Junior Gas Association:** Reception and Dance.

**April 22.—Western Junior Gas Association:** Annual General Meeting. Bath.

**April 22.—Eastern Junior Gas Association:** 'The Drying-out and Lighting-up of Vertical Retort Installations,' A. D. Duxbury. Bishops Stortford.

**April 25.—Southern Association of Gas Engineers and Managers (Eastern District):** 'Works Accident Prevention,' F. A. Sanders. Gas Industry House, 2.30 p.m.

**April 25.—Wales and Monmouthshire Junior Gas Association:** Annual Meeting. Film (and discussion) presented by Vacuum Oil Co., Ltd. Porthcawl.

**April 26—London and Southern Junior Gas Association:** All-day Visit to gasworks and industrial works at Reading.

**April 27.—Midland Junior Gas Association:** President's Day. Oxford.

**April 27.—Institute of Fuel:** Annual General Meeting, Connaught Rooms, Great Queen Street, 11 a.m. Presidential Address of Dr. D. T. A. Townend. Annual Luncheon, 1 p.m.; principal guest and speaker, Sir Harold Brown, G.B.E., K.C.B., Chairman, Fuel Research Board.

**April 28.—Manchester District Association of Gas Engineers:** Meeting, Engineers' Club, Manchester. Presidential Address of N. G. Appleyard.

**May 4-5.—Eastern Association of Gas Engineers and Managers:** Spring Meeting, Felixstowe.

**May 18-19.—Wales and Monmouthshire Association of Gas Engineers and Managers:** 45th Annual Meeting, Tenby. (First day social functions; second day business).

To meet the growing demand for gas at Chichester, formerly in the area of the Bognor Regis Gas and Electricity Company and now part of the Eastern Division of the Southern Gas Board, the Portsmouth system of supply is being extended to the city from the holder station at Emsworth. The main laying work is nearly completed and the supply will be available in the near future.

THE COUNCIL OF THE INSTITUTION, APRIL 4, 1950

# THE COUNCIL OF THE INSTITUTION, APRIL 4, 1950



*Left to right* (*seated*): J. E. Wakeford, M.B.E.; S. J. Sadler; C. E. Grimwood; Dr. H. Hollings, D.SC., F.R.I.C.; J. H. Dyde, M.SC. (Junior Vice-President); F. Wilson; J. D. Ashworth; G. P. Mitchell, M.I.C.E., M.I.MECH.E.; F. Dawson, B.SC.; J. T. Haynes, M.I.C.E.; Dr. W. T. K. Braunholtz, O.B.E., M.A., PH.D., F.R.I.C., Secretary; C. H. Chester, O.B.E., M.I.MECH.E., President; John Terrace, M.I.C.E. Hon. Secretary; F. M. Birks, C.B.E., M.I.C.E., M.I.MECH.E., Senior Vice-President; Dr. Harold Hartley, D.SC.; E. Crowther, M.ENG., M.I.C.E.; G. E. Currier, M.B.E., M.I.MECH.E.; G. G. Warne; D. W. Rees, M.B.E.; J. MacLusky. *Standing*: L. P. Ingram, M.SC.; W. K. Tate, M.A.; T. C. Battersby; A. G. Higgins, M.SC., F.R.I.C., Assistant Secretary.

*This photograph of the first meeting in the Council Chamber of No. 17, Grosvenor Crescent, was specially taken for the* Gas Journal *by their Staff Photographer, Edward Brown*, A.R.P.S.

# Letter to the Editor

## METER TESTING IN WALES

DEAR SIR,—In the paragraph on 'Meter Testing in Wales,' in the *Journal* of March 29, I am stated to have said that 'there were examiners all over England, but they were, as yet, not fully covering Wales.' These words are substantially what I said, but they constituted part of a reply made to a question on gas examiners which was raised during the general discussion on meter testing.

As reported they appear to refer to the number of meter testers in Wales. This interpretation renders meaningless the final sentence concerning 'five or six examiners who were each covering a large territory in Wales.'

Yours faithfully,
T. O. JONES,
Acting Secretary.

Wales Gas Consultative Council,
1 and 2, Windsor Place,
Cardiff.

March 31, 1950.

# Personal

Mr. **A. G. Verrall** (Epping) has been appointed a member of the Eastern Gas Consultative Council.

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Mr. **H. F. Snow,** of William Edgar and Son, Ltd., has been admitted to the Gordon Hospital, Vauxhall Bridge Road, London, for a major operation.

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Mrs. **G. O. Jones** has resigned from the Board of the Montevideo Gas and Dry Dock Company. Mr. **W. A. H. Keeley** has been appointed Managing Director.

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In the personal column on March 29 we referred to Mr. **R. Fill,** Northern Sales Manager of Smith Meters, Ltd. His name was incorrectly given and should have been Mr. **W. R. Gill.**

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Mr. **R. F. Bell,** B.SC., has been appointed recently as Assistant Engineer and Manager of the Falkirk District of the Scottish Gas Board (Edinburgh and South East Division). Mr. Bell, who is the president of the Scottish Junior Gas Association (Western District), is at present on the Technical Staff of the Tradeston gasworks, Glasgow, which he joined 12 months ago. Prior to nationalisation he was Chief Technical Assistant at Motherwell.

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Alderman **R. Turner,** Deputy Mayor of Bedford and Chairman of the Eastern Gas Consultative Council, was at a special meeting of Bedford Town Council on March 27 unanimously selected for nomination as the next Mayor of Bedford. Aged 68, Alderman Turner was for nearly 50 years associated with the Bedford District Gas Company and on his retirement on March 31, 1949, was General Manager and Managing Director of the company. He has played a considerable part in the affairs of the town, and as well as being a member of the Town Council he is also a member of Bedfordshire County Council.

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Mr. **H. J. Fountain,** one of the founders of the Clarkson Thimble Tube Boiler Co., Ltd., in 1926, retired from the position of Managing Director on March 31, having reached the retiring age, but remains on the Board of Directors as Consultant. Mr. **S. W. Spurr** has been appointed to succeed Mr. Fountain as Managing Director. Mr. Spurr has been in the employment of the Babcock and Wilcox organisation for over 20 years, during which time he has spent extended periods abroad on behalf of the Company and obtained a worldwide experience with boiler installations of all types. He joined the Clarkson Thimble Tube Boiler Co., Ltd., three years ago as General Manager and was appointed to the Board in 1949.

M. **Caquot** (France) has been elected President of the International Organisation for Standardisation in succession to Mr. Howard Coonley (U.S.A.). M. Caquot has had a distinguished career as a civil engineer. His achievements include the construction of the Madeleine Bridge at Nantes, the Lafayette Bridge in Paris, and the Pont de la Caille in Haute-Savoie, the construction of which constitutes the world's record in reinforced concrete. For his services to the allied cause during the 1914-18 war he was awarded the D.S.O. and the C.M.G.

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Mr. **George Clark,** O.B.E., J.P., who has been Managing Director of British Furnaces, Ltd., since the formation of the Company in 1921 and Chairman since 1936, has retired from both offices, but will retain his seat on the Board and act in a consultative capacity. He is succeeded as Chairman by Mr. **D. M. Henshaw,** who is Chairman of the B.H.D. Engineers, Ltd., a holding company comprising among others the Bryan Donkin Co., Ltd., and British Furnaces, Ltd. He will thus become Chairman of all the companies in the group. Mr. **P. Hopkinson,** who has been Manager of British Furnaces, Ltd., since 1922 and a Director since 1941, has been appointed Managing Director. Mr. Hopkinson, who joined the Company 44 years ago, is now paying his third visit to the Company's associates, the Surface Combustion Corporation, of Toledo, Ohio, for an exchange of information and data on the latest practice in furnace design and technique.

# Obituary

Mr. **W. F. R. Campling,** O.B.E., Works Director of Thomas De La Rue and Co., Ltd., died suddenly on April 1. He joined the Company in February, 1948, and soon became a Director of the then working subsidiary company known as De La Rue Insulation, Ltd., He was appointed to the Board of De La Rue in August, 1949. Before joining the De La Rue group, Mr. Campling was for 23 years with the County of London Electric Supply, Ltd., and completed his service with that Company as Regional Manager for the southern territory. During the war he served with the Air Ministry and Ministry of Aircraft Production.

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Mr. **William Wallace Parkinson** died at his home at Cheam on April 6. Mr. Parkinson, who was in his 83rd year, retired from active service in the Parkinson and Cowan organisation in 1946 after 57 years' unbroken association with the firm, during the later years of which service he was the Deputy Chairman of the parent body, Parkinson and Cowan, Ltd. He was grandson of the original William Parkinson who came to London in the second decade of the 19th century and joined Crossley Brothers, who founded the business. Thus three generations of William Parkinsons have maintained a family association with the gas meter business and at Cottage Lane Works, City Road, London, in particular, through more than 130 years. Mr. Parkinson was one of the original Directors of Parkinson and Cowan, Ltd., when that Company was formed in 1900 to amalgamate the two oldest gas meter makers, W. Parkinson and Company and W. & B. Cowan, Ltd.

# GAS ENGINEERS' NATIONAL GUILD

**East Midlands Branch.**—A meeting of members of the Gas Engineers' National Guild in the area of the East Midlands Gas Board, to form an East Midlands Branch of the Guild, will be held at the Victoria Station Hotel, Nottingham, on April 22, at 3 p.m. All the members of the Guild in that area and others eligible for membership (officers and senior or professionally qualified employees of the board) are invited to attend.

**West Midlands Branch.**—The Annual General Meeting of the West Midlands Branch will be held at the Queen's Hotel, Birmingham, on April 20, at 5 p.m.

Both meetings will be addressed by Mr. J. R. W. Alexander, Executive Chairman of the Guild.

**Scottish and other Branches.**—Mr. Alexander spoke at the Annual General Meeting of the Scottish Branch, which was preceded by dinner at Largs, on April 7. General meetings of branches of the Guild have recently been addressed by Mr. Alexander in Manchester (North Western), Leeds (North Eastern) and Taunton (South Western).

# Successful Salesmen

**The *Gas Service* National Competition, results of which were announced in the *Journal* of March 29, concluded with a successful prize-giving ceremony in London.**

**Above, right:** *Mr. F. G. Brewer congratulates the winner of the first prize, Mr. J. B. Maylam,* D.F.C., *District Manager at Tottenham.* **Above:** *Mr. C. G. Osborne (North Thames), who won second prize, and Mr. W. E. Laird (Canterbury) and Miss P. D. Knight (Altrincham), equal third prize winners.*

Before an audience consisting of the Chairmen and Secretaries of the Gas Salesmen's Circles, a pleasant ceremony was enacted on March 31, at the Goring Hotel, London, when Mr. F. G. Brewer, M.A., Secretary of the Gas Council, presented prizes for the first *Gas Service* National Competition.

An explanation of the circumstances prompting Walter King, Ltd., to organise this competition was given by Mr. Clifford A. King, Managing Director. It was, he said, the result of many papers having been received by familiar authors. It was felt by the publishers that new blood should be encouraged. Not only were the prize-winning papers excellent in themselves; they were the work of people who had never had anything published before.

The high quality of the 27 entries was stressed by Mr. R. J. Gregg, Publicity Manager of the Gas Council, who was a member of the adjudicating panel.

Presenting the prizes, Mr. Brewer referred to the competition as having provided a fine incentive for all salesmen, and hoped that it would become an annual event.

A vote of thanks to Mr. Brewer and to the Gas Council was proposed by Mr. G. W. Battison, Editor of *Gas Service*.

*Mr. Brewer at the prize-giving ceremony. Also in the photo graph are, left to right: Mr. Clifford A. King, the Editor of* Gas Service, *and the Editor of the* Gas Journal.

# Taxation of Trading Profits

## Gas Council's Submissions to Chancellor's Committee

ON behalf of the nationalised gas industry the Gas Council has, in response to an invitation from the Committee on Taxation of Trading Profits appointed by the Chancellor of the Exchequer, submitted a memorandum setting out submissions regarding the position of the area boards. The memorandum states that broadly the area boards are not required to earn profits in excess of the service of their financial capital, their surpluses accruing ultimately not to proprietors but to the community as consumers. Subject to any limitations imposed by the Minister of Fuel and Power with the approval of the Treasury they will accumulate general reserves and other surplus earnings for the purpose of supplementing their financial resources, but the application of such reserves and surpluses is statutorily confined to the objects and purposes of the boards.

The underlying intention of Parliament appears to have been that the basis of taxation of the nationalised industry should remain unaffected by nationalisation, though this is not the case as regards profits tax where now gas boards are liable to profits tax though some of their predecessor owners, being statutory undertakers, were not.

### Profits Tax

It is submitted that the principle by which distributions of profits to equity capital owners cannot be deducted from profits assessable to profits tax is inappropriate when there is no equity holder whose share of profits can be correspondingly adjusted; and that assessments to profits tax should take into account all fixed revenue charges. Accordingly Section 40(3) of the Finance Act, 1947, should be repealed with retrospective effect.

Section 40(3) of the Finance Act, 1947, provides, in brief, that interest and other revenue payments in respect of stocks issued as compensation for the nationalisation of assets, &c., shall only be deducted from profits assessable to profits tax having regard to the extent that the capital of the industry immediately before the acquisition of the assets consisted of debentures or other loan capital. The underlying assumption is that the limitation maintains unchanged the basis of taxation of the industry in that the undertakings which comprised the industry prior to the vesting date (in so far as they were liable to profits tax) would not have been allowed to deduct distributions of profit to holders of share capital. In fact the statutory undertakings taken over were not liable to profits tax and to levy profits tax on them negatives the underlying assumption. In companies the liability for profits tax falls upon the equity shareholders who are entitled to the balance of profits after prior charges have been met. From the point of view of companies as a whole the profits tax is recovered by a reduction in ordinary dividends. No such recovery is possible to the gas boards. The interest charges in respect of its financial capital are fixed and unless those charges are fully allowed for in computing profits tax, the tax on those charges must be provided out of surpluses which themselves bear income tax and profits tax. The financial effect is serious since when gas boards have created reasonable reserves against bad years they will not only have to cover their fixed charges but in addition to earn a surplus out of which to pay profits tax on a large proportion of the interest charges. It is considered that the prohibition in Section 40(3) is based on a misconception and should be removed since the additional liability must be ultimately borne by the consumers.

### Transferred Activities

The Gas Council's second submission is that where activities are transferred from one nationalised industry to another the profits of the transferred activity should be assessed on the transferor industry in accordance with Section 31 of the Finance Act, 1926.

Nationalisation, it is pointed out, is still to some extent in an experimental stage and a reshuffling of assets by transfers of special activities from one nationalised industry to another is likely. Such transfers may probably be required by legislation. They should not result in undue charges in respect of taxation to the nationalised industries as a whole. It appears to be wrong that where an activity is transferred from one nationalised industry to another both industries should be assessed to tax in respect thereof for an ensuing period of (broadly) 12 months; the transferor industry having as a result paid tax for one year more than its period of ownership. The result is to burden customers with a double charge for one year on the profits of a transferred activity.

This proposal will be unnecessary if it is decided to compute income tax assessments on the actual profits of the fiscal year.

# Oxford Gas Staff Dinner

The annual dinner for the staff and employees of the Oxford and District Gas Undertaking was held on March 24 at the Forum Restaurant, Oxford, followed by a dance and whist drive. The Chairman of the Southern Gas Board, Mr. Owen R. Guard, the Deputy Chairman, Mr. S. E. Whitehead, and two members of the board, Mr. G. L. Perkins and Mr. A. E. Smith, together with Mr. Alexander Tran, the Divisional General Manager of the Northern Division, Mr. E. B. Craddock and Mr. H. G. Broadbridge, General Managers of the Aylesbury and Banbury and District undertakings, attended with their wives.

Mr. **S. E. Whitehead,** proposing the toast of 'The Oxford and District Gas Undertaking,' said he had known the Oxford company and the Oxford undertaking for more than 30 years, and he had always known it as a very go-ahead and prosperous undertaking. It remained so to-day, in spite of all the trouble.

'You people are doing a very good job,' he said, 'and I think this sort of function is one that should be encouraged.

'We also took over a packet of trouble, but as a board we do mean to try to convince the City Fathers and the University that a gasworks is a thing of beauty.'

Mr. **S. C. Bentley,** responding, welcomed the members of the board and the other representatives of the industry, and said a very important part was played by the Oxford undertaking in the life of Oxford.

'We realise that there is a great responsibility on us to maintain the traditions of the gas industry as they apply to this City,' he said.

'We realise that we are now creating what will be the traditions of the nationalised industry, and we feel there is enormous responsibility on us to see that those foundations shall be well laid.'

He thought they had made a good start under their new constitution, and said the carrying out of the change which had taken place in the last 12 months was bound to lead to very involved and complex work, and meant extra work on the staff.

Mr. **A. Tran,** proposing 'The Southern Gas Board,' said the Aylesbury and Banbury representatives were particularly welcome there, because he was extremely pleased at the spirit of co-operation that existed between the various groups.

Mr. **Owen R. Guard,** replying, said no one had wiser counsellors or greater friends than he had round the board table.

Everyone, whether in the home, the shop, office or factory, was at present working under a fairly severe strain, and gatherings of that sort did a lot towards helping things to run smoothly.

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**During a Recent Lunch-Break** at the Silvertown factory of the India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., six employees were presented with engraved clocks on completion of 50 years' service. The presentation was made by Mr. C. R. Cushman, factory superintendent, and the recipients were Messrs. P. Frost, J. Holland, J. R. Lawrence, J. T. Nelson, W. Perry, and A. R. Rolfe—all still in the company's service. To date 20 employees with more than 50 years' service to their credit are still actively engaged in the factory.

# National Benzole Champions

THE National Benzole Co., Ltd., revived a popular pre-war custom of 'dining' their champion division on March 31, when they gave a complimentary dinner at the Old Ship Hotel, Brighton, to the Southern Division, who had won the coveted title of 'Premier Division, 1949.'

Mr. R. J. Smith, Director and General Manager, presided over a large gathering, which included Mr. B. Saxby-Hawkins, Manager, the sales staff, and senior members of the administrative personnel of the Division. Also present were many prominent members of the local benzole producing undertakings, including, from the Southern Gas Board, General Managers J. T. Haynes (Western Division) and W. K. Tate (Eastern Division); the South Eastern Gas Board, Messrs. B. P. Bezant (Tonbridge and Sevenoaks), G. J. B. Cox (Tunbridge Wells), S. W. Hammond (Eastbourne), L. G. Humphrys (Bexhill-on-Sea), and J. W. Townsend (Kent County Division).

In addition there was a good muster of tar distillers, including Messrs. R. H. E. Clark (General Manager) and J. Collings (Works General Manager) of the South Eastern Tar Distillers, Tonbridge, and C. N. Kemp (Works Manager, Lennard & Company, Shoreham), B. Kilpatrick (Burts & Harvey, Ltd., Totton), and G. F. Poleglaze (Works Manager, Totton) of the South Western Tar Distillers.

Proposing the toast of 'Our Benzole Producers,' Mr. **R. J. Smith** cordially welcomed these gentlemen and said that his Company was relying on all producers of benzole to do their utmost to increase extraction, because every possible additional gallon would count.

Mr. **J. Collings** replied and Mr. **L. Halsey,** Sales Manager, proposed the toast of the 'Premier Division.' The **Chairman** then presented the new Championship Shield to Mr. Saxby-Hawkins.

Mr. **Saxby-Hawkins** said that he and his staff had decided to keep the shield for two more years so as to gain the 'hat trick,' and would then give some other division a chance. He expressed appreciation of the hard work put in by his clerical staff, and asked the Chairman to present Mr. F. T. Perren, Chief Clerk, Tonbridge, with a pewter tankard.

The toast of 'the Runners-Up' was proposed by Mr. **W. L. Roney,** London Divisional Manager, followed by a response by Mr. **G. E. Roberts,** Eastern Divisional Manager.

A vote of thanks by Mr. **C. G. Brook,** Joint Assistant General Manager, to Mr. R. J. Smith for the genial way he had conducted the proceedings, and also for his thoughtfulness in reinstituting these dinners, was received with loud acclamation, and an enjoyable evening terminated with a few words of thanks and good wishes by the Chairman.

## Technical State Scholarships

The Ministry of Education has announced that the number of Technical State Scholarships available this year is to be increased from 100 to 120. Of the scholarships 80 will be available to candidates under the age of 20 on July 31, and up to 40 for candidates aged 20 or over. There is no upper age limit for the latter awards. These scholarships will be offered to students to enable them to pursue full-time degree courses—normally leading to an honours degree—or courses of equivalent standard at universities, university colleges or establishments of further education.

Candidates must have completed a course leading to an Ordinary National Certificate or Diploma or course of equivalent standard, and normally have been in full-time or part-time attendance at an establishment for further education for not less than two years immediately preceding August 1.

The award of a Technical State Scholarship will not exempt the holder from the normal admission requirement of a university. Successful candidates must make their own arrangements for acceptance by a university, university college, or technical college.

Explanatory leaflets and application forms may be obtained from principals of further education establishments or from the Ministry of Education, Curzon Street, London, W.1.

## News in Brief

**The Joint Coke Committee** of the East Midlands, South Western, and West Midlands Gas Boards was dissolved on March 31.

**The Telephone Number** of the auxiliary office of Babcock and Wilcox, Ltd., at Audrey House, Houndsditch, London, E.C.3, has been changed from Avenue 4273 to Avenue 7171.

**The Council** of the Institute of Welding have awarded the Sir William J. Larke Medal, for the best paper read to the Institute during the year, to Mr. R. G. Braithwaite, M.I.C.E., M.INST.W. Mr. Braithwaite is welding consultant to Braithwaite and Co. (Structural), Ltd., and was last year Chairman of the Birmingham Branch of the Institute. His paper deals with the control of distortion in arc welding.

**Coal Output.**—The miners increased their output in the week ended April 1 by over 92,000 tons. They produced a total tonnage of 4,472,000, compared with 4,379,000 tons in the previous week. The decline in manpower continues with a loss of 700 workers in the week ended March 25, 200 of whom were workers at the coal face. Gas available at gasworks during the week ended March 31 amounted to 10,862.4 mill. cu.ft., against 10,996.4 mill. in the week before. Over the same period, 982.1 mill. units of electricity were sent out for public supply, compared with 955.3 mill.

# Local Committee Functions

The first meeting of the Bristol Sub-Divisional Committee, set up by the South Western Gas Consultative Council, was held at Bristol on March 24. The meeting was presided over by Councillor A. W. Loveys, J.P., and the Sub-Divisional Manager of the South Western Gas Board, Mr. C. R. Ingham, was in attendance.

Mr. **Loveys** outlined the purposes it was hoped the local committee would serve. Its main function would be to keep the consultative council informed of matters arising from the use of gas within the localities from which the members were drawn. It would investigate and use its good office to solve, in co-operation with the gas board officers, problems of local origin and interest. On matters that were common to, or affected, the whole of the area of the South Western Gas Board, it would be free to make enquiries of or representations to the consultative council. Contact between the two bodies was direct because the committee included those members of the council who were resident within the area covered by the committee.

With regard to complaints by gas users, Mr. Loveys referred to the expressed view of the consultative council that the gas board should first have been told what the complaint was and have been given an opportunity to investigate it and, if possible, of giving satisfaction to the consumer before the services of the local committee were invoked. The purpose of the consultative council and the 11 local committees which were in the course of being set up (Bristol being the first) was to represent and serve the gas-using public. It was for that public to make the fullest use of them. The members of the council and the committees, although nominated by representative bodies, were free to exercise their personal judgment on all the matters that were brought before them.

Mr. Loveys dealt with questions, mostly about procedure, asked by members of the committee. In response to an enquiry he said that suggestions for improvements in gas appliances would be welcomed.

Tribute was paid to the gas board by a member of the committee for the improvement effected in the supply of gas to the Thornbury district.

Mr. **Ingham,** after giving an explanation of the method of charging for the use of slot meters, told the committee of the desire of the Bristol Sub-Division of the gas board to serve the public well and he assured them that every complaint that reached him would be dealt with promptly and efficiently.

The committee elected as its Chairman Councillor L. J. Poole.

# TOWN GAS *versus* COOKERS

By ARTHUR FORSHAW, M.Sc.

***EDITOR'S NOTE:*—In the *Journal* of February 15 we published a paper by Mr. C. Whitehead Middlesbrough Division, Northern Gas Board, on the 'Thermal Rating of Gas Burners.' The author argued that until such time as a satisfactory method for measuring the combustion characteristics of gas is found there can be no adequate means of classifying gases for the purpose of designing fixed orifice injectors for appliances. He maintained that appliances are more versatile if fitted with variable injectors and also if methods to control the amount of primary air to the burners are adopted. In the following article Mr. Arthur Forshaw states another point of view.**

NO subject is of more immediate interest—and importance—than that concerned with adapting domestic appliances to work satisfactorily with the present '1,001' varieties of town gas put at the disposal of the user by the various undertakings.

Let us, however, be quite clear at the outset that the makers can provide appliances to meet any constant combination of calorific value, specific gravity and pressure. If these three remain constant, no trouble can arise and this article would not have been written.

It is, however, notorious that, in spite of continual exhortations from those influential enough to carry weight with their fellow engineers, and of cries for help from those who suffer from the disabilities, the first of the three variants—calorific value—differs from undertaking to undertaking (26 different statutory calorific values have recently been mentioned); the other two not only vary from undertaking to undertaking, but also within the territories of each separate undertaking, and that mostly in an unpredictable way.

## The Two Systems Available

To deal with this state of affairs, there are available two systems:—

(1) The burners are supplied with gas through injectors with a variable adjustment device which enables the volume of gas to be varied in an endeavour to ensure that the correct rated number of B.Th.U. reaches the burner. To meet the cases where high pressure and low calorific value result in small highly-aerated flames, some form of primary air control must be fitted. Normally, no governor is fitted. It will be noted that by using these two controls any combination of calorific value, specific gravity, and pressure can be dealt with, but that once the controls have been set they are the equivalent of a fixed injector *without* governor. Of themselves—*i.e.*, automatically—they do not deal with variation in any of the three gas characteristics mentioned. They merely enable variations to be dealt with by their further manipulation.

(2) The burners are supplied with gas through injectors drilled to ensure that where the gas is of a known calorific value and specific gravity, the correct rated number of B.Th.U. reaches the burner at a constant pressure of 2½ in. W.G. To ensure this last, the cooker is fitted with a pressure governor. For reasons similar to those mentioned under (1), a primary air control is fitted to each burner, although, owing to the governor, high pressure cannot reach the injector and the air control is, therefore, of less importance than with ungoverned variable injectors.

It will be seen that system (1) ignores the most important factor, the one responsible for the biggest deviation from the rated output of an injector—*viz.*, pressure—for no governor is fitted. Pressure, moreover, while being the most important factor is also the least constant for it varies from hour to hour and is different at different levels on the same district.

On the other hand the efficacy of system (2) is based on the use of a governor.

Apart from the lack of a governor, to which further reference may be necessary, it might be supposed at first glance that system (1) will meet the case of an undertaking which changes its calorific value and/or specific gravity, whereas system (2) will not because, although, as already pointed out, there is no automatic correction for the changed gas, yet system (1) can be manually altered to meet the changed conditions. On further consideration, however, this view will be seen to be ill-founded, for the following reasons:

(1) It is a fact that, other things being equal, a fixed injector gives better results in thermal efficiency and effectiveness of working than can a variable arrangement.

(2) That apart from this inherent inferiority, the variable arrangement relies for its effectiveness, such as it is, on correct setting, and is, therefore, dependent on the skill and experience of the individual fitter.

(3) If gas quality alters sufficiently to make a fixed injector unsatisfactory, it will also make the existing setting of a variable injector unsatisfactory, *particularly* the latter, where it has no governor.

(4) In either case a sufficiently altered gas quality necessitates the visit of a fitter. It is clearly much easier for him to unscrew a set of fixed injectors and replace them by others correctly drilled for the altered gas than to adjust each individual burner to an equally correct consumption of the altered gas, a task which requires a stop watch, inspection of the meter test hand, and infinite patience.

(5) The most important factor in upsetting burner output is pressure. This fluctuates whether quality alters or not. Only a governor can deal with this, while to fit variable injectors *and* a governor is the most costly arrangement possible.

## Inevitable Conclusions

The conclusions that force themselves on the conscientious investigators are then:—

(1) That the best arrangement is a governor with fixed injectors and that, provided the calorific value range has been adequately covered by a sufficient number of sets of injectors (in our case, a separate injector for every 30 B.Th.U. difference) a considerable difference in either calorific value or specific gravity must be made before any replacement is required.

(2) That to revert to variable nipples would be of questionable benefit.

(3) That, whatever else is decided upon, a governor on each cooker is a *sine qua non.*

It is significant that these conclusions, particularly No. 3, are supported by the opinions—and by the practice founded on them—of several of the technical advisers of leading undertakings in the gas industry itself.

# PRACTICAL ASPECTS OF DESIGN AND CONSTRUCTION IN GASWORKS INSTALLATIONS*

By S. C. HERBERT, B.Sc.(Eng.), A.M.I.Mech.E.,
Mechanical Superintendent, Kent Suburban Division, South Eastern Gas Board.

**In this paper an attempt has been made to set down a few of the problems encountered by the gasworks maintenance engineer concerning constructional materials, plant design, and fuel economy in an effort to indicate the directions in which modern engineering practice can assist the gas engineer and the manufacturer in their efforts to obtain equipment capable of performing its allotted task continuously, efficiently, and reliably, with a minimum of attention from the maintenance staff.**

INDUSTRIAL progress during the past 25 years has resulted in the discovery and development of many new materials, processes, and methods of design and construction, while shortages and rising costs have made us in this country particularly conscious of the need to avoid waste in every sphere of industrial life—in fuel, in materials, and in labour.

Many gasworks can say that they have played their part in the effort to recover from the events of the last 10 years, and many new ideas have been introduced offering opportunities for immediate savings in constructional materials and labour, reductions in operating and maintenance costs, and the use of new materials to supersede those in short supply. To the gas engineer, however, the large sums of money expended annually in repairs and maintenance are a constant reminder of the extensive deterioration which continuously occurs in gasworks plant, and of the essential need to apply to the full any new technique which offers a reliable means of reducing this expenditure.

## Conditions of Operation

Gasworks conditions have always posed serious problems to the plant designer. Continuous operation at full output is a regular routine, under combinations of dust, dampness, mechanical abrasion and chemical attack which react severely upon structural, mechanical, and electrical gear. The gas-making processes function without pause for months at a time, and failure of mechanical equipment for more than a few hours results in loss of gas production and may be detrimental to the subsequent performance of the gas-making plant itself.

The provision of standby mechanical plant has long been regarded as an essential feature of gasworks policy in any situation affecting the gas-making process, and often includes the use of alternative fuels for power production. The present-day plant provides an additional problem, however, in the need for the ceaseless application of mechanical aid to secure the continuous functioning of the gas-making process, and the equipment provided for this purpose is so closely incorporated with the structure of the plant as to form an integral part of it. These conditions appear in the extractor gear fitted to both continuous and intermittent vertical retorts, in the self-clinkering mechanical grate on gas producers and water gas plants, and in the automatic operators controlling the cyclic processes of C.W.G. plants and coke oven heating equipment. In such cases, the designer can no longer arrange to bring spare mechanical gear into action by the manipulation of valve and switch, and must exercise, therefore, still greater care in the initial design to ensure that adequate life will be obtained and that repair or replacement can be quickly accomplished when required.

## Constructional Materials

Past experience has established the superior resistance exhibited by certain ranges of materials to particular working conditions, the outstanding example being that of the refractories in high temperature conditions.

In a similar manner, cast iron has long been used where high compressive strength, complicated shapes, rigidity, resistance to corrosion, ease of machining, and freedom from porosity and from distortion at reasonably high temperatures have been required. Increased foundry and pattern-making costs, and unattractive working conditions, have now contributed to a shortage of iron castings, which is promoting the adoption of other, less satisfactory, materials; but the gas industry holds many applications in which cast iron remains supreme and where it is to be preferred in spite of long delivery and high cost.

Steel has become a very popular and adaptable material, particularly with the advances made in welding techniques. Its higher tensile strength and increased workability are largely responsible for its wide adoption in place of cast iron.

In gasworks practice, steel construction should be regarded with caution. Greater strength or lighter construction confer benefits which often show an economy in initial cost or power consumption, but steel is vulnerable to corrosion, and permanent steelwork must receive adequate treatment to prevent deterioration, either by periodical scraping and painting or by the application of protective coatings of various kinds which, although they may prove to be exceptionally durable, will be very expensive in first cost. Structural steel also offers poor resistance to the abrasive action of coke and clinker, while steel vessels used for the production of water gas, and welded steel vessels and mains containing foul gas, provide maintenance problems in certain circumstances. In the former, extensive corrosion and pinholing of plating occurs, and in the latter, severe cracking takes place through the welded seams which proves very difficult to repair.

The alloy steels amply repay their extra cost when used in selected applications. Heavy wear in mechanical parts and chute linings, and burning of stokers' tools can be successfully resisted by the lower grades of abrasion and heat resisting alloys respectively, and high-strength steels are in common use on heavy elevator and conveyor driving shafts where, in combination with manganese steel sprocket wheels, they provide years of uninterrupted service where serious loss in gas production and extensive dismantling of gear attend the renewal of these parts.

The aluminium alloys are receiving increasing attention in domestic and industrial applications, but it is necessary to guard against electrolytic corrosion in damp conditions, which is particularly active when copper and its alloys are brought into contact with them. This effect also occurs to a limited degree in contact with steel, and may be prevented by galvanising or cadmium plating the steel. Chemical corrosion occurs when in contact with alkalis, and for this reason aluminium alloys should not be buried in concrete or plaster. Resistance to atmospheric corrosion is very good, but the materials will not withstand undue mechanical wear.

Structural designs using aluminium alloy sections are very flexible, because of the ease with which the sections may be

* Paper presented to the Southern Association of Gas Engineers and Managers (Eastern District), March 28, 1950.

produced by extrusion through inexpensive dies, and aluminium alloy castings are being applied to internal combustion engine components, portable motorised tools, and power transmission equipment. Extruded sections and rolled sheet find many uses in road, rail, and air transport, and building trade applications include window frames, scaffolding, and roof sheeting. In heavy engineering, high cost and low resistance to mechanical damage have restricted their use, but notwithstanding these disadvantages an all light-alloy bascule bridge has been constructed in Sunderland which has economised considerably in weight and power requirements, while mine-cages have been built in aluminium alloys for North America for some years and light alloy booms have been installed on several medium-sized draglines in this country to explore the possibilities in this class of equipment. Figs. 1 and 2 show two views of the

*Fig. 1.*

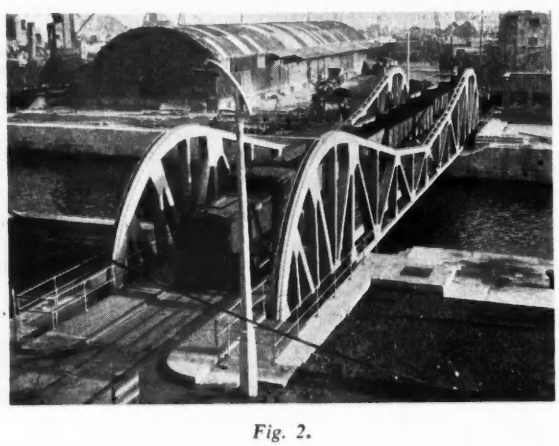

*Fig. 2.*

aluminium alloy bascule bridge mentioned above, which carries road and rail traffic across the entrance to the Hendon Dock at the Port of Sunderland and which spans a 90 ft. width of waterway. This bridge has a moving deck 109 ft. 2 in. long, and contains 61.5 tons of aluminium alloys.

Considerable advantages are to be gained in the factory from the use of aluminium alloys, and Fig. 3 shows a typical example of an overhead travelling crane whose main structure is built entirely in these materials. This crane spans a shop 70 ft. wide and weighs about 15 tons. The same crane in steel would have weighed 22 tons 10 cwt., and it will be seen, therefore, that a considerable saving results not only in the strength and proportions required in the machine itself but also in the track and supporting structure upon which it runs.

As experience of applications of this nature accumulates, this class of structure could well be found of service in suitable situations in the gas industry.

Among the lesser-known non-ferrous alloys which are proving very useful in the gas industry are the zinc-base die-casting alloys, which are employed in the mass-production of complicated castings formerly made either in sand moulds or as pressings, and involving heavy tooling and machining costs. The new process and materials enable these components to be produced within close limits of accuracy, and with little or no subsequent machining, at a fraction of their original cost. They are frequently employed for electrical conduit fittings and for office equipment, and in conjunction with light alloy tubing provide an electrical carcassing system which, while not quite

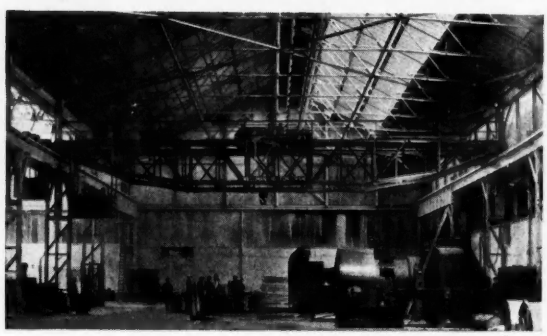

*Fig. 3.*

so robust as steel, will give good service in most applications in gasworks plant in which steel conduit is acceptable.

Monel is an alloy of nickel and copper which develops a strength equal to that of steel, together with high resistance to most corrosive conditions. Monel setscrews have proved very useful in place of steel for the fixing of cleaning doors on retort house collecting mains and washing plant and in the dischargers of intermittent vertical retorts, and their use in severe conditions ensures rapid and unfailing extraction without the risk of breakage in the tapped hole.

The plastics industry continues to extend its range of operations to a remarkable degree and, while its principal industrial application lies in the electrical field, mechanical engineering is receiving increasing attention, in bearings for heavy rolling mills, synthetic gears machined from the solid, and pressure treatment of porous castings. Transparent plastic materials are replacing glass in selected applications, and claims are made for lightness, efficiency of light transmission, and toughness. They are obtainable in sheet form to match most types of corrugated roof sheeting, and require no frames, being self-supporting. Considerable deflection occurs before failure and the material does not splinter. Its disadvantages are high cost and a soft surface which can be easily scratched.

In the gas industry, plastic materials appear largely as mass-produced proprietary articles such as electrical fittings, pressure gauge cases, control knobs and handwheels, and similar items, but experience will produce many further applications. Transparent plastics can be expected to appear in the near future in many fields, for such purposes as gauge glasses, and inspection ports in gas treatment plant, where their superior properties will recommend their use as a substitute for glass.

Rubber has found its principal use in transport, but its excellent powers of resistance to all kinds of chemicals is rapidly extending its sphere of operations. The gas industry employs rubber in a number of specialised applications; in belt conveyors, in pumps for coke-quenching systems, handling hot, abrasive, and slightly acidic recirculating water, as a protective lining to shell and impeller, in oscillating bearings,

vibration dampers, and flexible couplings as a flexible load-carrying material, in shot-blast plants and reciprocating screens as a protective lining bonded to steel deadplates, and in various forms of flat and V-belt drives as a medium for power transmission.

In building construction, all kinds of materials and methods developed for special purposes have been applied to the construction of weatherproof buildings, and in many ways they do not compare favourably with orthodox brick construction. Experience in the gas industry vouches for its resistance to severe atmospheric conditions, good appearance, and low maintenance charges, advantages of great importance to the gas engineer.

Concrete has been employed for foundation and piling work for many years with complete satisfaction under conditions accepted as far more severe than are generally encountered above ground, and its use above ground is increasing with great rapidity, many examples standing in gasworks today as witnesses to its success. Progress in design and constructional methods has been rapid, and still further

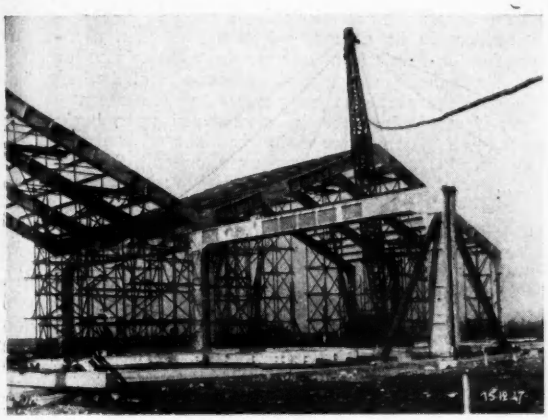

*Fig. 4.*

improvements are appearing on the horizon, in the development of prestressed construction.

Efforts are being made to effect a reduction in the time required for construction, and in timber for shuttering, by the use of standardised steel and aluminium alloy shuttering sections and by the production of precast concrete sections and slabs with special joints arranged to bolt together or to be grouted after erection with a minimum of shuttering applied at local points. Fig. 4 shows a typical example of precast hangar construction, using bolted joints, in which the precast units weighed from 3½ to 6 tons each, and the completed roof spans 98 ft. 6 in. Precast sections of this size require the use of portable cranes for their handling and erection, but the ability to cast such sections centrally, under rigid control, enables much higher stresses to be employed and results in economies in materials and finished weight.

The new field offered by the application of prestressed construction, in which the reinforcement is stressed by a permanent and carefully regulated tensile load prior to the application of the working load, will produce further economies by utilising high-tensile steel wire reinforcement and will further reduce cross-sectional area and weight.

The method is one for the specialist in concrete design and no general rule can be laid down, but large numbers of precast and prestressed units have been produced, both in this country and abroad, for railway sleepers, power transmission poles, fencing, factory buildings, bridges, and other purposes, with complete satisfaction.

Considerable reductions in floor weights have been achieved by utilising hollow clay floor slabs prepared so that their assembly on a skeleton staging provides the requisite spaces in which to cast the reinforced concrete beams required to carry the floor loads, a thin skin of concrete over the tiles sufficing to provide a hard-wearing surface (Fig. 5). This type of floor is very common in factory and office buildings and is an economical form of construction which could be utilised in the gas industry much more frequently than is the case at the

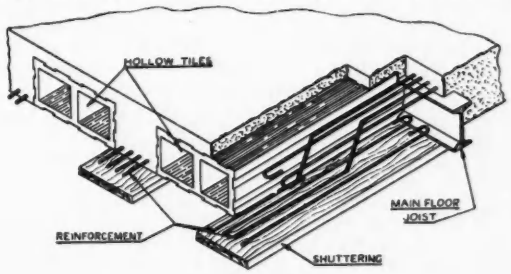


*Fig. 5.*

present time. It is interesting to note, in passing, that very similar hollow tile floor constructions have been discovered, dating back to the Roman era, 2,000 years ago, which were used to accommodate central heating arrangements in their public buildings.

In this Age of Metals, timber still finds countless applications for which no alternative has yet been able to give quite the same advantages. Its load-carrying capacity, resilience, light weight, toughness, and resistance to weathering effects and to many chemical products, are a combination of qualities giving outstanding service. Scarcity of seasoned timber, and wastage occurring from natural flaws in the lumber, have promoted efforts to produce artificial timber boardings with enhanced and more uniform properties. These efforts have resulted in the laminated plywoods and grainless 'improved wood' sheets, obtainable in a variety of hardnesses and densities, which can be used for all types of partitioning and panelling work.

In transport, for general service, the success of the timber body over other materials is very clearly established not only by reason of its longer life but because of the ease of repair. Protection against undue mechanical damage is supplied by metal rubbing strips, and in tipping bodies a lining of thin steel sheet is often fitted to assist in the discharging of the load.

Lack of slates and tiles has extended the employment of asbestos sheeting to roofing purposes in domestic as well as industrial premises. The material has several advantages, including light weight, excellent resistance to atmospheric conditions, and the large sizes of sheet available. It is frequently employed to enclose temporary structures, when it forms a very convenient and rapidly erected covering. Its use, however, is not recommended on permanent structures, if at all avoidable, owing to its poor resilience and brittleness, which increase with age and cannot be detected except by tests to destruction. Asbestos sheeting is unsafe to walk upon without duckboards in all the single-sheet forms of roof covering spanning the standard 3 ft. 6 in. to 4 ft. 6 in. purlin spacing, although very durable service is obtained on closely-spaced purlins such as are found on industrial slated roofs, while asbestos slates are quite satisfactory on a close-boarded roof. Improved designs are being developed, incorporating fabric reinforcement and cavity-sheeting constructions.

## The Work of the Drawing Office

The attainment of good results in any plant depends as much upon correct design and construction as upon correct materials, and the same importance must be attached to the work in the drawing office as to the shop and site work.

Drawing office methods are today the cause of many costly delays and alterations to plant on the site. The staff is often sectionalised to such a degree that a draughtsman deals with a specific type of detail with no knowledge of the surroundings into which that detail must be fitted. One sometimes finds that comprehensive layouts of plants are not prepared, with

the result that numerous sub-assemblies are laid out and detailed without a reference appearing as to their proximity to surrounding items of equipment, and drawings of access platforms are completed with little or no indication of the duties to be performed from them. The accurate correlation of countless drawings of this nature on a large plant is a very heavy responsibility and is almost impossible of reliable accomplishment. The result is frequently a hurried consultation on the site with the client's supervisor, followed by alterations costly in themselves and wasteful in time and labour.

The contractor is not able to accumulate the same experience of the working of plants over long periods of time as is gained by the gasworks engineer and his staff, and the draughtsman, whether he be in the contractor's or the gasworks drawing office, would be able to produce more satisfactory and consistent work if he could appreciate the reasons underlying provisions requested by the works engineer or chemist, and if he could see the results of his work, in the erection stages and in operation, more frequently than he does at present. He should be given the opportunity to realise at first hand the implications of a slip of the pencil which passes unnoticed until erection is attempted. In this way he would be able to appreciate the problems of the other members of the team, not only among the erection staff, but among the operators and the maintenance gangs who follow after, and to collect some part of the experience necessary for success in his profession; experience which, like the skill of the journeyman, is becoming rarer under the policies of over-specialisation advocated in the interests of speed, efficiency, and economy.

## Material Handling Equipment

Conveying and elevating systems are frequently the lifeline upon which the production of gas depends, and in many cases are duplicated to safeguard the process work, particularly where no reserve storage capacity exists to maintain the continuity of the process for a few hours.

Belt conveyors give first class service and seldom justify duplication, although they are liable to damage if left in contact with hot material for any length of time, and their inability to elevate at angles much in excess of 18° limits their usefulness where space is at a premium. Idlers, and head and tail drums, should be rubber-covered for protection against damp, abrasive materials, and prepacked grease and oil filled idlers give very good service.

In the elevating field, belt-bucket elevators give very good results with adequate attention to bucket design and methods of fixing, and the vertical elevator is preferred to the inclined

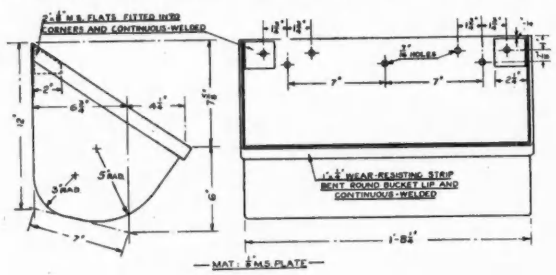


*Fig. 6.*

type, since less space is required, skids and skid-bars are eliminated, a minimum of lubrication is necessary, and an almost silent elevator is obtained. Fig. 6 shows the type of bucket developed at Sydenham for 40 tons per hour capacity, fitted to a 24 in. belt. Jackson fastener bolts are used for the attachment of this bucket to the belt, and the corner stiffeners on the back of the bucket will be noted, which provide the strength required to prevent tearing of the weld, a frequent occurrence prior to its addition.

The enclosure provided for belt-bucket elevators must be fitted with a convenient detachable section of a size sufficient to permit the use of belt stretchers, and with a means of access between the belt-strands for the fixing of the buckets.

The chain elevator is a much heavier proposition and is subject to heavy wear when handling coke. Its treatment of the material is, however, considerably less violent than that received from the belt-bucket elevator, which is usually a higher-speed machine of the digging type, relying upon centrifugal force for a clean discharge of material.

Gravity and lip bucket conveyors offer the considerable advantage of horizontal and vertical conveyance of material in the same machine together with the ability to load and unload at several points at will. The lip-bucket conveyor avoids the complication of special loading devices required by gravity types, owing to the overlapping of the buckets, but is unable to lower the load down a vertical track. The disadvantages of these machines are serious under continuous operation, in that lubrication is difficult, and heavy and uneven wear of the pins and links is experienced, leading to unequal stretch and bad tracking of the conveyor. While nominally a continuous conveyor, the discharge from the buckets is spasmodic to a degree requiring an allowance of up to 20% above the conveyor capacity in plant fed directly from the buckets, if spillage is to be avoided.

In a class somewhat alone is the skip hoist, which, while intermittent in its delivery of material, offers a means of elevation economical in both power and maintenance. The use of a twin-skip design minimises the size of the buffer-hoppers, and the plant can be arranged to discharge at different levels if required. Wear is concentrated upon buckets and ropes, both of which are easily replaceable. Brakes must be kept in good order, and over-travel cut-outs fitted to guard against failure of automatic reversing trips. Adequate space must be left in the lower pit beneath the bucket to prevent grounding and the slackening of the ropes, and feed chutes and buckets must be designed to avoid overfilling of the bucket. Generally, it is advantageous to fit two ropes, either to be capable of carrying the load, and rope drums should be designed to permit the smooth travel of the ropes round the drum without slip. Automatic switches are preferably controlled directly from the drum shaft and not by means of bucket trips.

Telphers and transporters are frequently employed for the handling of bulk materials, using hook-on skips and grabs or twin-rope grabs, and combine the high hoisting speed of the crane with high-speed horizontal conveying. Their disadvantages include high initial and maintenance costs of tracks and supporting structures and the need for an operator, plus at least one extra man when hook-on skips are in use.

In general, twin-rope grabs are preferred for bulk handling, permitting controlled discharge at any height, but the hoist has additional drums and rope sheaves and is consequently more expensive. The single-rope grab can be opened either by a hand-rope or by contact with the stock pile, of which the former would be impracticable where any considerable horizontal distance must be traversed. The single-rope grab can, however, be applied to any crane and forms an ideal tool for intermittent use, in spite of the increased hoisting and lowering times required to discharge the load. This grab also avoids the discharge of clouds of dust when opening, since the grab is drawn away from beneath the load when resting on the stock pile.

In the unloading of materials from railway wagons, considerable ingenuity has been expended in the development of wagon tipplers. While many of these designs give first class service, the operation consumes considerable power, and damage to wagons often occurs. Considerable excavation and heavy foundation work are required, and it is felt that more attention could be devoted to the development of the hopper-bottomed railway wagon fitted with controllable discharge outlets discharging into shallow feed-hoppers beneath the track. Trucks of this type have received some attention at Sydenham and hold 14 tons of coal on a 9 ft. wheelbase chassis measuring 19 ft. 3 in. over buffers, 8 ft. 3 in. wide, and 9 ft. 4 in. above rail level (Fig. 7). The slight loss in capacity compared with the 16 ton standard coal truck can be reduced by close attention to loading gauge and size; and the abolition of tipping gear and of the need for a feeder beneath the rail hopper, combined with the very small hopper required, which

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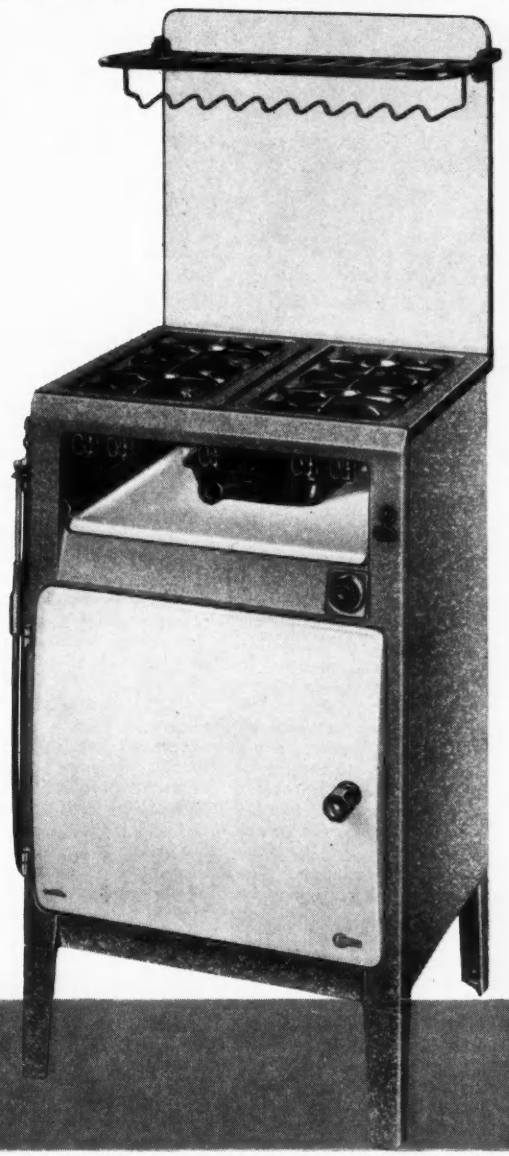

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can be contained within the gauge of the track itself, are very considerable advantages.

The use of portable equipment enables a number of short-duration and intermittent jobs to be carried out at different points by the same equipment, utilised to its maximum extent. Numerous handling problems at Sydenham have been overcome in this way using loading shovel, tipping lorry, mobile crane, tractor, steel plate sledge, and wheeled trolleys with

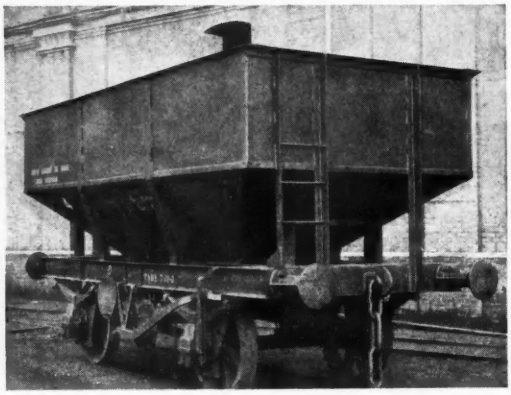

*Fig. 7.*

detachable bodies to suit the job, and result in very flexible handling of the sundry transport duties arising daily, with low upkeep cost of the equipment and interchangeability of comparatively inexpensive items of expendable plant.

In all handling systems, modern techniques are assisting to cheapen costs of construction and of spares. Welding is universally applied to conveyor and elevator buckets, and copper-bearing steel provides some measure of corrosion resistance. Wear-resisting steels are in regular use for skids and skid-bars, rails, and railwheels of heavy travelling machinery. The deposition of special steels by electric and gas welding processes increases wear-resistance and provides a means of repairing heavy local wear, and renewable inserts provide a further means of restoring worn surfaces. Flame-hardening of the surface of high-carbon steels supplements these methods and permits a hard skin to be produced on accurately-machined surfaces without distortion. Deposition of new metal by electrical and by metal-spraying processes are common methods of reclaiming worn parts and of providing very hard wearing surfaces. In the gas industry all these processes can play an important part in the effort to increase working life and to reduce expenditure in spares. Mechanical grates in water gas and producer gas plants experience severe wear on clinker-crushing rings, which can be restored by the electric welding process using wear-resisting materials. The teeth of all kinds of heavily-loaded sprocket wheels may be similarly treated in situ. Railway track crossings have been restored by these methods for many years, and equal success is obtained with smaller details such as internal combustion engine camshafts and ratchet drives operating vertical retort dischargers. The electro-deposition of chromium upon worn journals of high-speed turbines, blowers, and exhausters, followed by grinding to size, is quite satisfactory, while high-carbon steel gears, sprockets, cams, and similar items can be given a wear-resisting surface, subsequent to final machining, by the flame-hardening process. All these materials and methods should be kept in mind continuously so that any increase in life of equipment offered by such techniques may be applied at the first opportunity, in order that maximum durability and minimum idle time may be obtained with every item of gasworks equipment.

## Mechanical Requirements

The mechanical engineer of a gasworks welcomes the present trends towards universal total enclosure of working parts and adopts the principle wherever possible. It provides for the exclusion of abrasive dusts and corrosive vapours, greater protection from danger to the operators than will ever be obtained from guarding added as an afterthought, greater precision in construction and functioning of the working parts, and the application of more efficient means of lubrication.

At Sydenham, enclosed worm and spur gear-boxes are employed on all heavy drives, direct-coupled to the prime-mover wherever possible, and with direct coupling or chain drive to the machine. One-piece welded baseplates are preferred, integral with the driving shaft supports, to preserve alignment, and flexible couplings are fitted between prime mover and gearbox.

For medium powers and speeds, V-belts are employed, with a single pair of open gears or a chain drive to the machine, particularly where rapid renewal of the machine shaft assembly is required from time to time. These drives are fitted with $\frac{1}{8}$ in. mild steel plate guards, galvanised after made, and with adequate means for inspection and lubrication provided, and wired fronts are specified for all V-belt drives to prevent mistakes in lubrication.

Hydraulic-oil power provided by high-speed electric pumps, can often replace bulky mechanical low-speed drives, particularly when speed control is required, and will realise an increase in mechanical efficiency and a reduction in size of unit and in mechanical wear. Lubrication is provided by the hydraulic fluid, and pressures up to 2,000 lb./sq. in. have given first class service in the operation of vertical retort dischargers and rotary grates for gas producers.

Some rotary drives experience considerable shock loads at intervals and can be irreparably damaged unless steps are taken to minimise their effects. Belt drives in themselves provide resilience and ability to slip under excessive loading, but direct-coupled and chain drives need some form of slipping clutch, shearing pin, or other safeguard. The shearing pin, usually made of steel, brass, or copper, is the simplest and cheapest device to fit, but it is essential that the edges of the shearpin holes remain undamaged, to ensure a clean break. The holes are sometimes provided with hardened bushes where frequent shearing is probable, and clearance holes in both members are required, through which the broken pieces in the opposite member may be punched out. Such a device takes time to repair and may not be acceptable for this reason. The slipping clutch is satisfactory in many situations, electro-magnetic and magnetic-fluid types having much in their favour. Friction clutches are susceptible to damage if continuous slipping takes place. The hydraulic coupling provides an efficient alternative and is completely automatic in its action at all speeds. It is not suitable for drives requiring the maintenance of exact speed ratios, as its action depends upon relative slip between the two shafts. For a given maximum input torque and speed, the hydraulic coupling will apply the required output torque at the expense of a reduction in output speed, which may fall to zero without damage to the coupling or overloading of the prime mover. This form of drive has been successfully applied to road and rail transport and at Sydenham is operating discharger rams on horizontal retorts and oxide disintegrators with efficiency and reliability. The maintenance of alignment between the prime mover and driven shaft is of great importance, since the hydraulic coupling itself is a rigid unit unable to accommodate any but the smallest misalignment. Rigidity of the baseplate must be insisted upon, with careful initial alignment, adequate stop pins, fitting bolts or wedges, and three-point suspension if at all possible.

*(To be continued.)*

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A special light-weight fireproof cement for covering steelwork to prevent buckling when exposed to flames in burning buildings has been announced by the Eagle-Picher Co., Cincinnati, U.S.A., and is referred to in a recent issue of *Steel*. When it is applied in a layer 1¼ in. thick, the cement, it is claimed, will retard the effect of great heat for 3 hr. It is sold as a grey powdered material which is mixed with water to form a stiff paste which is trowelled on to ribbed metal lath wrapped around the steelwork to be protected.

# GAS QUALITY AND APPLIANCE PERFORMANCE

**Following is our report of the discussion on the paper on 'Gas Quality and Appliance Performance' which Mr. Leslie T. Minchin, B.Sc., M.Inst.Gas E., presented to the Southern Association of Gas Engineers and Managers (to the Western District on January 19 and to the Eastern District on February 28). The paper was published in the *Journal* of March 15 (pp. 650-665).**

LIEUT.-COLONEL **J. A. GOULD** (Chairman of the Eastern District), in congratulating Mr. Minchin on his paper, said that his own interests were confined largely to such changes in quality as affected distribution and the passing of the gas through the meter. The author was a specialist dealing with a specialised subject, and they would all agree that the maintenance of a constant input to the consumer's appliances involved serious economic considerations.

Dr. **J. G. King,** Director, Gas Research Board, said the difficulties of the higher production costs associated with gas load variations, the high sale price of gas-burning appliances which precluded expensive additions, and other factors all combined in a problem to which there was not yet a complete answer. They would all like to think that the town gas of any district would not vary in combustion characteristics except within narrow limits, and that the flexibility of the appliances used would exceed those limits. But could that be done without increasing gas production costs, and what, indeed, was the range of gas composition over which typical appliances gave a high efficiency performance?

Taking the latter first, it seemed evident to him that their knowledge was not as it should be. Mr. Wood had given some data in the 44th Report of the Joint Research Committee, but it was very incomplete. Further, the load factor of the burner must be considered, since flexibility almost constantly decreased as the load increased, and to a different extent with different gas qualities. It would not be sufficient to make appliances more readily adjustable since, as they knew very well, fluctuations of gas quality were often of short duration, and frequent adjustment, particularly by inexpert hands, would be quite impracticable. If a remedy to the main problem was found through the appliance it must be of a self-adjusting character.

Thoughts such as that had led the author to say that the remedy lay on the side of closer control of gas quality. If he was right, what was the control to be, and what effect would it have on the economics of gas production? The Wobbe index was suggested in order to ensure a constant heat input, but would the Wobbe index fully achieve that? At the same Wobbe index gas composition could vary and that could affect heat input by affecting the shape of the flame and the rate of heat transfer, or even completeness of combustion. Appliance changes might still be necessary, therefore, to ensure constant thermal output, even if the Wobbe index were standardised.

The author did not say how the production engineer was to do this, or suggest how much it would cost, nor how the basis of thermal change for gas was to be worked with a gas of variable calorific value when the method of measurement for sale was by volume. He (Dr. King) had once suggested recourse to methane synthesis catalysts for changing gas composition to limit the range of fluctuation of composition. It would no doubt be expensive but catalysts were steadily becoming more applicable to large scale processes. It was true that the carburetting of water gas by methane would greatly reduce the problem in combustion characteristics which was presented by using oil-carburetted water gas to meet peak loads (methanised gas with a calorific value of 506 B.Th.U., specific gravity of 0.44, and a Wobbe index of 760).

## Uniform Orifices

His remarks did little more than emphasise the case which Mr. Minchin had made for a better understanding of the problems of gaseous combustion and which he had placed before the meeting by reviewing so ably the state of existing knowledge of methods of assessing combustion characteristics. He would be pleased to know that the Gas Research Board had recently examined the A.T.B. and had solved the difficulty to which the author referred in the manufacture of uniform orifices. These had been made by punching, not drilling, and the makers had been provided with a large supply which showed correct rates of flow to within plus or minus 0.5%. The way was therefore clear for the continued production of satisfactory standard instruments. If, however, the author had designed and could produce an equally efficient apparatus at lower cost he wished him luck.

The Gas Research Board was trying to increase the extent of background knowledge by studying combustion research in general, also by examining the combustion characteristics of gas mixtures step by step. The present stage of the work was the study of three component systems, the final stage being the addition to them of the minor constituents of coal gas which had effects out of proportion to their amounts. The Research Board also hoped to examine the flexibility of certain typical appliances at several levels of calorific value within the range of town gas now distributed. The first experiment was with a gas fire; probably it would have been wiser to have started with a gas cooker. These experiments on the practical issues should be directly helpful in this problem and so, in the long run, should the more academic projects related to combustion research. The Board had now a fairly wide programme on combustion research both at Beckenham and Leeds which involved a number of different aspects of fundamental work which ranged from the structure and stability of diffusion flames to primary and secondary aeration studies and the kinetics of the combustion reactions to the theory of high-speed industrial heating. This should lead to something helpful.

## The Non-Aerated Flame

The author had given so many details of the associated problems that one could continue for a long time to discuss them, but he (the speaker) must limit himself to just one or two. He agreed with the author that while much had been done towards the understanding of the aerated flame their knowledge of the control of the non-aerated flame was less complete. It seemed obvious that the normal gas appliance, particularly that for domestic use, must at present have a fixed orifice injector and, however carefully the appliance was set, using for example the new burner which the North Thames Gas Board had designed and which represented a valuable improvement in servicing, there must be a variation of performance with aerated burners, the root cause of which was the variation of combustion velocity with degree of aeration. If only they could think of some method of varying automatically the degree of aeration as certain of the characteristics of the gas altered they would have the perfect condition. There was no sign of such a development, and indeed its form was difficult even to visualise. It could only be approached by continuing combustion research of the type the Gas Research Board and certain area boards were conducting.

In the case of non-aerated flames it was not really correct to say that there was no primary aeration. In one of the Research Board's projects it had been shown that certain proprietary burners induced aeration to the extent of giving a gas/air mixture containing some 15% of the total air requirement. It was quite possible that continued work on the aerodynamics of jets, allied with fundamental work on air entrainment would give a lead towards the better understanding of such flames.

To sum up, he felt that the paper fell into two main parts. The first called for more work on combustion research and he was entirely with the author in that. The second postulated the improvement of gas quality by inducing greater uniformity at the point of production, but it seemed to him that this was complicated by considerations of the economics of gas production. It was an interesting fact that the complete gasification projects in which the Gas Research Board was interested would produce a final gas consisting of the three simple fuel gases, hydrogen, CO, and methane, whose combustion characteristics would be relatively less variable. He felt that the issue for the moment was mainly that of the improved design of appliance burners with improved control, although he felt that the future might well provide in time a less variable town gas.

Mr. **G. H. Fuidge,** Chief Physicist, South Eastern Gas Board, said the author had pointed out that the problem of combustion characteristics of town gas and their effects on appliance performance was one which concerned both the production and utilisation sides of the industry. Personally he would like to feel that instead of the problem being one which each side considered the other ought to solve it was one to the solution of which each side should endeavour to make the maximum contribution. The gasworks manager should make as constant a gas as possible, compatible with his various production problems, and the utilisation technicians in conjunction with appliance manufacturers should make appliances possessing the maximum tolerance to changes in gas characteristics and should do everything possible to ensure that they were correctly adjusted.

## Varying Calorific Values

The author drew attention to certain difficulties of the Gas Acts of 1916 and 1920, and one must agree that it was unfortunate that such a large number of different standard calorific values were established throughout the country. Had the industry been able to set one standard a large proportion of their problems would never have arisen. Nationalisation gave a splendid opportunity to remedy the situation. Mr. Minchin was also right in pointing out that the thermal discharge of a burner at a constant pressure depended on the Wobbe index rather than on calorific value. It was difficult to imagine, however, any satisfactory arrangement for paying for gas which did not require a standard calorific value so that gas volumes could be translated into therms. Was it not going a little far, however, to suggest that the ordinary gas consumer could not open the tap of his appliance to compensate for a fall of Wobbe index. There were very few applications which did not have a good margin of heat output ; the instantaneous water heater had perhaps the least margin, particularly in cold weather. It was important to realise that appliances were, in fact, very appreciably tolerant to changes in combustion characteristics and did not demand gas of absolutely constant quality. The industry had never been able to supply a really constant gas, but it had given satisfactory service to the consumer. If this were not so the gas industry would hardly have developed to its present dimensions. Moreover, poor performance of appliances was not necessarily due to variations in combustion characteristics ; it was known, for instance, that many small undertakings had had difficulty in maintaining a constant calorific value and also in giving at all times an adequate pressure.

With normal methods of gas production, whether by carbonisation alone or by carbonisation plus water gas production, the variations in gas characteristics usually kept within the tolerance of the appliances. It was at times of peak demand that the difficulties usually arose, when owing to the use of unusual gas-making methods the gas characteristics changed considerably, generally with a fall in Wobbe index and A.T.B. number, while at such times the consumer actually required more heat from his appliance. There would therefore seem to be a case, as suggested by the author, for increasing the calorific value at such times to keep the Wobbe index more nearly constant. Any new methods of meeting peak loads which produced a gas of characteristics similar to those of normal coal gas would be a great help towards the solution of this problem.

## Criteria for Control

So far as combustion characteristics were concerned one of the great difficulties as explained by the author was that the term covered a complex set of phenomena and there was no single criterion which defined all the characteristics. The two most useful simple criteria appeared to be the Wobbe index and the A.T.B. number. If the proportions of coal gas and water gas in a mixture were varied their properties tended to go up and down together, and it had been assumed by certain workers that they were closely related. However, recent examination of the day to day variations of town gas had shown that in fact there was no useful correlation and the two properties must be considered to be independent. This made very difficult the problem of producing a gas which gave in all respects a constant performance on a burner since close control would be required of calorific value, specific gravity, and A.T.B. number. An attempt to control all three properties would give the works manager little or no freedom in his manufacturing processes. The question then arose that if control of combustion characteristics was to be attempted, which of the two criteria was the more important. On the whole he was inclined to the view that control of Wobbe index would be more useful. Specific gravity was a more fundamental property and more easily measured than A.T.B. number, and as the author had indicated, variations in Wobbe were the cause of a large proportion of the difficulties arising from changes in gas composition. Inadequate service from instantaneous water heaters could result from a fall in Wobbe index and incomplete combustion due to over-gassing could result from a rise in Wobbe index. Wobbe index was applicable to non-aerated as well as aerated burners. Experience suggested that if Wobbe index of normal town gas was kept within reasonable limits, difficulties were unlikely to arise from independent variations of A.T.B. number.

The author had deprecated the use of air controls on burners as a means of compensating for changes in the combustion characteristics, and he would support that view. Owing to the wide variety of different calorific values and gas characteristics throughout the country it had been convenient for the appliance manufacturer to supply burners with variable gas and air controls. Thus any gas undertaking could adjust the appliance to suit its own gas. On the other hand he did not think they could expect the consumer to make day to day adjustments to deal with variations in gas quality. It was unlikely that the adjustments would be correct. For many years it was the policy of the South Metropolitan Gas Company only to supply appliances with fixed injectors and fixed air openings, and there was singular freedom from complaints of bad burner performance. Although the gas supplied was wholly from horizontal retorts there were appreciable variations in specific gravity and somewhat wider variations in A.T.B. number. With the greater degree of standardisation of calorific value and gas quality possible in a nationalised industry they were of opinion that the use of fixed injectors could be extended and that this would give improved standards of service, and in particular greater safety by the avoidance of excessive gas rates due to maladjustment of appliances. To decide the sizes of the fixed injectors it should be possible to classify the gases supplied by different undertakings according to Wobbe index of each group covering a range of, say, 10%.

Mr. Minchin had referred to the combustion diagrams used at Old Kent Road in work on combustion characteristics. To obtain more precise information as to the relative effects on appliance performance of burner design and gas characteristics they were extending the use of the combustion diagram by applying it to a burner used under normal conditions within the appliance. This enabled one to draw on the combustion diagram an important limit which could not be obtained when the burner was tested away from the appliance, namely, the advent of incomplete combustion as shown by the $CO/CO_2$ ratio of the products. It was interesting to record that for cooker hotplates, for example, the limit roughly corresponded at the lower gas rates with the limit for luminosity of the flames, but that the air/gas ratio to give complete combustion rose rather steeply when some limiting gas rate was reached. This illustrated the importance of avoiding excessive gas rates which might arise from a large increase in Wobbe index.

Attention had been drawn to the dearth of knowledge on the effects of gas quality on non-aerated flames. The flow conditions of the gas before reaching the burner and within the burner were undoubtedly very important and these were affected by the density of the gas since the viscosity did not vary appreciably. Other things being equal, the specific gravity was the significant variable. The author had applied the term 'incipient lift point' to a different phenomenon from that referred to in their papers ; in their case they applied it to the liability of the flame to lift in a draught, since that was the first evidence of unstable conditions in the flame.

## Appliance Design

Mr. **Arthur Forshaw** (R. and A. Main, Ltd.) said that in approaching the matter entirely from a technical point of view the author had been led to criticise the Gas Acts of 1916 and 1920 adversely because 'they set up a new god—the gas calorimeter.' Those who held that view might be reminded that the calorimeter was an infinitely more just god than the sperm candle god which it superseded, and that its primary function was to provide a sound basis for the sale of heat units to the consumer. He refrained from discussing whether or not it actually did that, but he would say that it was doubtful whether the proposed new idol, the Wobbe index, which was merely a numerical expression and not additive for mixtures, could fulfil that function which was, after all, fundamental from the accountant's angle.

His own experience of the technical side as one interested in appliance design and performance extended back into the candle power era when gas was rich and supplied at low pressure. The present problem of maintaining constant burner output did not arise. So long as sufficient air was injected into a bunsen burner to prevent deposition of carbon the used and the undertaking were satisfied. Candle power fluctuated little; if pressure rose and caused too long a flame it could be checked at the tap, but the limits of pressure fluctuation were small about an initially low figure. Later, as the importance of candle power waned and expanding demands had to be satisfied by the use of a diversity of gas-making methods, the difference between the gas of one undertaking and that of another became so much greater that burners could not be moved from one to the other with dissatisfaction to the user. When that difference was supplemented on the distribution side by the use of greatly increased pressures, fluctuating to meet diurnal peak loads, the makers had to provide some means of making their appliances work satisfatcorily. After a period of attempting to provide each undertaking with injectors specially drilled for its own particular quality and pressure of gas—a task impossible to reconcile with rapid and inexpensive production—the makers progressed to the variable gas injector with the variable air adjuster. With some types of appliance the variable gas injector had to be supplemented by a pressure damper. The vogue of that arrangement lasted in its heyday for some 20 years, and it was still an important means of dealing with diverse qualities of gas; it did not, of course, deal with pressure differences.

## Removal of a Major Hindrance

Some 15 years ago the old Gas Light and Coke Company turned its mind to cooker design. It had one great advantage over the appliance makers in that it did not have to convince its customer that alterations to current practice were justified, for that customer was itself. Briefly it removed the biggest hindrance to constant output from a burner by adopting a pressure governor on every cooker. As the gas was otherwise naturally of constant quality no adjustment of injector or checking of air was required. So far as they were concerned the mere addition of a governor had brought them back to the simple injector of the original cookers current up to 20 years previously.

The appliance makers, either with a view to disposing of production surplus to the Gas Light and Coke requirements or of adapting the system to their own cookers were faced with the problem of making the system suitable for gases of qualities quite different from that of the Gas Light and Coke Company, and in number, as the author had quoted, at least 26. It was clear from past experience that such a variety was incompatible with mass production. Consideration, however, showed that leaving out the extremes of quality which accounted for a very small percentage of the total volume of gas throughout the country, the range of calorific value lay between 400 and 530 B.Th.U. per cu.ft., while the other main variable, specific gravity, was probably between 0.4 and 0.65, although there was much less certainty about the latter limits because many undertakings were somewhat hazy about their specific gravity and the effect on it of whatever methods they might use for boosting output at need.

## Choice of Injectors

The various appliance makers dealt with the range in various ways. His own Company divided the calorific value range into four classes of 30 B.Th.U. (except for the lowest, which was 40 B.Th.U.) and for each class considered what the specific gravity was likely to be. On that basis they prepared for each appliance a set of injectors drilled to give the requisite output for each burner. The appliances were fitted at their own works with the injectors appropriate to the calorific value and specific gravity of the gas, based on figures supplied by the undertaking. If the specific gravity was rather abnormal it might justify fitting the appliance with injectors from the set above or below that which would be selected by consideration of calorific value only. For a calorific value below 400 or above 530 B.Th.U. each case was considered on its merits. To deal with differences in flame quality which caused low numbers and high aeration when tested by an A.T.B., all burners were provided with an air adjuster.

What would be the effect on this system of adopting the Wobbe index in place of calorific value as the criterion of gas quality? Initially none, for in effect the injectors were designed to give an output calculated on calorific value and the inverse square root of specific gravity, and that was precisely the Wobbe index. The trouble, if any was to be anticipated, would be when gas quality was changed. It had been contended with some show of reason that a fixed injector system could not deal with changes and that therefore they must regress to a variable injector which, after adjustment each time, could deal with them. He thought that view was a mistaken one. No-one would deny that, if correctly drilled, the fixed injector with governor gave better results in thermal efficiency and in effectiveness of boiling than any adjustable arrangement. Apart from this inherent inferiority the adjustable arrangement relied for its effectiveness, such as it was, on correct setting and was therefore at the mercy of the individual fitter, and that was not a tender one. If gas quality altered sufficiently to make a fixed injector with governor to run satisfactorily it would also make the existing setting of an adjustable injector unsatisfactory. In either case sufficiently altered gas quality necessitated the visit of a fitter, and it was reasonable to say that it was a much easier job for him to unscrew a set of fixed nipples and replace them by others correctly drilled for the altered gas than to adjust each individual burner to the correct consumption of the altered gas, a task which required a stop watch, inspection of the meter test hand, and infinite patience. The greatest factor in upsetting burner output was pressure. This fluctuated whether quality altered or not. Only a governor could deal with this, while to fit adjustable injectors and governor was the most costly arrangement possible.

## Typical Gaseous Fuels

It was possible, given the requisite range of constituents, to make a mixture to conform to any Wobbe index in reason. Whether the result would always prove easy to produce or successful in use was another matter. The point could be illustrated by using the classes into which, as he had said, his Company divided the usual calorific value range and putting against them the specific gravity they would need to show a Wobbe index of 700:

| | | |
|---|---|---|
| 400 | — | 0.37 |
| 440 | — | 0.395 |
| 470 | — | 0.45 |
| 500 | — | 0.51 |
| 530 | — | 0.573 |

The possibility of getting such correspondence with the usual gases available did not seem very promising, and usually the specific gravity moved in the opposite direction to that required. 'Technical Data on Fuel' gave the following 'typical gaseous fuels' in round figures:

| | C.V. | Specific gravity | Wobbe index | C.V. of mixture with air | Air required cu.ft./cu.ft. gas |
|---|---|---|---|---|---|
| Blast furnace gas | 92 | 1.01 | 86 | 54.6 | 0.69 |
| Low temperature carbonisation | 889 | 0.62 | 1,129 | 96.3 | 8.23 |
| Horizontals | 560 | 0.40 | 885.5 | 94.8 | 4.91 |
| Continuous verticals | 540 | 0.43 | 823.5 | 94.6 | 4.71 |
| Continuous verticals (steamed) | 475 | 0.48 | 685.7 | 93.9 | 4.06 |
| Coke oven (debenzolised) | 525 | 0.38 | 851.7 | 94.3 | 4.57 |
| Producer (hand fired, coke) | 126 | 0.90 | 132.8 | 64.6 | 0.95 |
| Producer (mechanically fired, coal) | 163 | 0.87 | 174.8 | 71.4 | 1.28 |
| Producer (mechanically fired, coke) | 132 | 0.90 | 139.7 | 66.2 | 1.00 |
| Blue water | 295 | 0.55 | 397.7 | 91.7 | 2.22 |
| Carburetted water | 500 | 0.63 | 630.1 | 94.9 | 4.27 |
| Carbon monoxide | 318 | 0.97 | 322.8 | 94.1 | 2.38 |
| Hydrogen | 320 | 0.07 | 1,210 | 94.7 | 2.38 |
| Methane | 995 | 0.55 | 1,342 | 94.6 | 9.52 |
| Propane | 2,500 | 1.5 | 2,041 | 100 | 24 |
| Butane | 3,200 | 2.0 | 2,263 | 100 | 31 |

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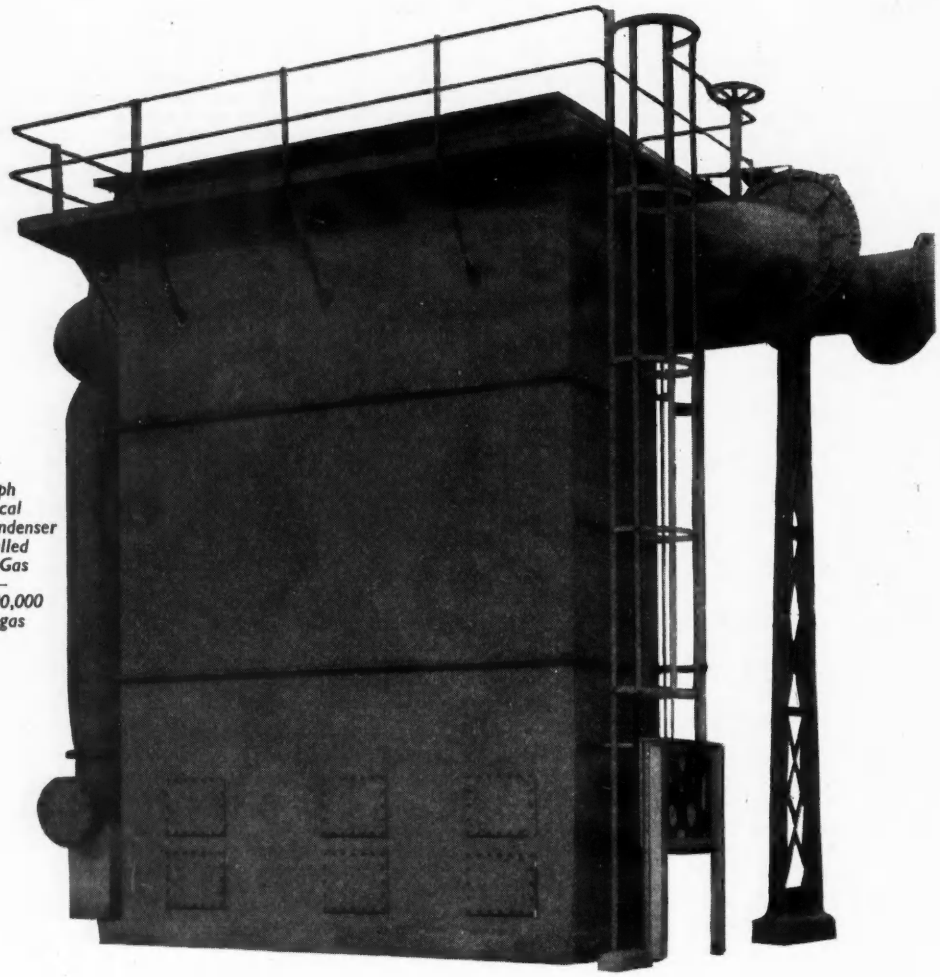

*The photograph shows a Vertical Tube Gas Condenser recently installed for the Perth Gas Department—capacity 5,000,000 cubic feet of gas per diem.*


VERTICAL TUBE

GAS CONDENSERS

*by*

NEWTON CHAMBERS

NEWTON CHAMBERS & Co. Ltd., THORNCLIFFE, Nr. SHEFFIELD

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From these figures it would be seen that not only the specific gravity of town gas tended to be higher as the calorific value dropped, but also that the air requirements were generally smaller where the specific gravity was higher ; in other words, the gases requiring less air were naturally endowed with greater momentum at a given pressure. This was because, inputs of B.Th.U. per hour being equal, low calorific value necessitated a bigger volume of heavier gas and accounted for the necessity of providing air adjusters with fixed injectors. As the author had pointed out, that tendency was fortunately to some extent offset by the combustion characteristics of hydrogen, the content of which generally fell with rising specific gravity, and so the speed of burning was reduced and with it the over-aeration or tendency to light back. On the other hand, the use of paraffins, such as methane, propane, and butane for enrichment had a similar effect on combustion characteristics. for unless hydrogen was added to them their flames were very much less stable and did not easily aerate as the last figures in the table indicated.

He did not wish the author to think he was crabbing his suggested standard when he pointed out the difficulties that occurred to him ; in particular that the Wobbe index, unlike the calorific value, was a pure number without dimensions. He was grateful to him for raising again the question of gas standardisation. It was a matter of paramount importance to the appliance maker and so far as he was concerned he could point to a paper he read to the Manchester District Institution as long ago as 1912 in which he urged the provision of constant calorific value and uniform pressure and the elimination of sulphur. No doubt he was not the first to do that, and most certainly many others followed. The author's allusion to the Institution of Gas Engineers symposium of 1941 reminded them that, powerful as was the advocacy then put forward for the same causes, they were still very much as they were 40 years ago. Now that the production and distribution sides had a new and centralised set up he hoped that the appliance side of the industry might look forward to better things and be enabled to give of its best without the distractions, inconveniences, and positive disadvantages that had hampered its efforts for so long.

## Limited Practical Use

Mr. **F. E. Mills** (North Thames Gas Board, Watson House) said that while he must support any scheme which would result in a more constant Wobbe index, if it was practicable and if its cost was not prohibitive, he would like to remind the members that a constant Wobbe index would not necessarily result in a constant heat input to appliances. Changes of atmospheric temperature and pressure might change the heat intput by 10% or possibly more if, as in non-aerated burners, the orifice was subjected to wide temperature changes. Constant pressure governors were only constant within rather wide limits, and between batches of the same appliance there must be differences in the orifices and their discharge coefficients, due to manufacturing tolerances.

He would add a word of warning about using Davey's equation even as a rough relationship between Wobbe index and A.T.B. number. He had recently had to examine statistically some hundreds of determinations, and it was found that the A.T.B. number followed the calorific value more closely than it followed the Wobbe index. The only practical use for the relationship would be to predict the A.T.B. number of an unusual gas, but it broke down completely for mixtures containing peak load gas made from oil. Such gas played havoc with the Wobbe index, but had very little effect on the A.T.B. number. It was very doubtful whether the maintenance of a constant Wobbe index would necessarily result in a constant A.T.B. number.

Regarding the German Code of Practice, he suggested that there would be great difficulty in convincing anyone near London that 500 B.Th.U. per cu.ft. was an unsuitable gas to supply, although it was outside the German limits. It was interesting, however, to compare such limits with the present-day variations in our gas, and for that purpose they might take plus or minus twice the standard deviation, which included 95% of the values. During a recent period of 12 months the variations so calculated were plus or minus 11 B.Th.U. on calorific value, plus or minus 0.06 on specific gravity, plus or minus 47 on Wobbe number, and plus or minus 7 on A.T.B. number (B scale). If they were allowed a free hand in respect of benzole washing he thought they might keep the sulphur down to the 11 grain limit. Considering that they had been literally bombed to blazes and were now sending out about 20% more gas than in 1938 he did not think they were doing so badly compared with pre-war Germany. Other area boards might be doing even better.

They wanted to give an even better service if they could, and he suggested two or three ways of doing so. In the first place they did not accept Mr. Minchin's rather dismal view that appliances could not be made more tolerant to changes in gas quality ; there was activity at Watson House in that direction. Mr. Minchin himself had spent a lot of time designing more tolerant burners. Even if he had no further progress to make, the application of some of his earlier ideas should give manufacturers something to work on in making better appliances. Secondly, they found that existing appliances could cope reasonably well with the normal variations of present-day gas provided they were adjusted in such a way that they were properly aerated when the gas was at its mean value.

## Flame Matching Burner

The way to do that, they suggested, was by means of the flame matching burner, and before Mr. Minchin was tempted to improve it by introducing scales or measuring points on it, he would like to give very briefly the principles of its use. It was simply a bunsen burner of such a size that the fitter could carry it in his waistcoat pocket, and of such dimensions that it gave a properly aerated flame when supplied with average North Thames gas, *i.e.*, the sort of gas which was sent out most frequently. They had found it convenient to use the A.T.B. numbers of the gas in determining that average. When the fitter was adjusting an appliance he simply matched the flame of the appliance against the flame of the matching burner. He need not make elaborate measurements ; he was simply asked to make the two flames look alike. If the gas was normal the two flames would be properly aerated. If the gas was abnormal both flames would be left abnormal, but the flame of the appliance would revert to normal when the gas became normal, *i.e.*, by definition, for most of the time.

Manufacturers appeared to differ a little in what they considered the proper aeration for an appliance, but they had found that a cone height which was one-third of the total height of the flame covered most appliances with one or two exceptions which were dealt with specially. This proportion was not seriously affected by pressure and so the matching burner did not need a governor. As Mr. Minchin had expected, there was some difficulty in making the burner reproducible, but they had nearly 3,000 of them which had passed their tests. They were also exploring whether same principle could be applied to setting gas rates to the mean Wobbe index, but there were difficulties in this, and the solution might not be simple.

Thirdly, there were the abnormal conditions to consider, when it was more important to make a lot of gas than to be fussy about its quality. In their case this usually meant a high percentage of C.W.G., and for many years they had found that trouble on such occasions was minimised by deliberately keeping up the calorific value, as had been suggested by Dr. Pexton. Mr. Minchin would probably say that they were keeping up the Wobbe index, but he preferred at the moment to say that it was the increase of calorific value that was keeping up the A.T.B. number. At any rate it was a step in the direction which the author was advocating, but they did it only in exceptional circumstances.

Since reading the paper it had occurred to him that engineers might be encouraged to make more use of the principle, and so give better service to consumers, if the official requirements were so altered that a yearly average were used instead of a quarterly one. This would enable the calorific value to be lowered in summer and correspondingly raised in winter. As a start he would suggest that the regulations might stipulate that the average for a quarter should be not more than 2% lower than the declared value, and that the average for four successive quarters should be not less than the declared value.

## The Author's Reply

Mr. **Minchin** replied briefly to the discussion and expressed some disappointment at the fact that no gas engineer had had anything to say. Dr. King had mentioned an interesting way of producing water gas which would be less liable to light back than the ordinary water gas. He (Mr. Minchin) thought that carburetting with propane and butane was better than oil carburetting, and he foresaw a great use for propane and butane in this country in the future. He hoped increasing attention to combustion characteristics would encourage the use of

(*Continued on p.* 128.)

# THE FITTER AND THE JOB*

By S. WALLER,
Harwich Gas Undertaking, Eastern Gas Board

THERE are three types of workman. First there is the man who takes a pride in his work and will put his best into any job he is given to do. At the other end of the scale is the man who thinks he knows all there is to know about the work, and consequently has not taken the trouble to learn his job properly. In between those two comes the man who *can* do a good job if he likes to take the trouble, but will do a slip-shod job if he thinks he can get away with it. He is the type of man who will say: 'That's near enough,' In one sense it is 'near enough.' He has fixed an appliance; he has used pipe of an adequate size; he has regulated the appliance more or less satisfactorily, even if he has not followed the instructions on the card issued by the makers.

Let us regard the job. The pipe run is of adequate size, but is more conspicuous than it need be. It could have been concealed more by running it over the picture rail or beside the door jamb, and it is away from the wall or ceiling. The flue is slightly out of perpendicular. The gas rate is too high giving incomplete combustion, with consequently a further visit for maintenance, and so it goes on. Therefore it is not 'near enough.'

Now take the man who is painstaking and tidy. Being conscientious, he reads the maker's instruction card, fixes the appliance, regulates it according to directions, and instructs the consumer. The pipes are concealed as far as possible, the appliance, being regulated correctly, will not require any further attention apart from routine maintenance, the whole job is neat and tidy. The consumer is satisfied. To the fitter 'near enough' is not good enough.

We hear people say that the workman of today is not as good as the workman of yesterday. I do not agree. There were always some bad workmen, and there always will be. It must be our aim to eliminate the bad ones. Here the larger undertakings have an advantage over the smaller ones A large undertaking covers a district where there are facilities for evening classes and courses for the City and Guilds examination for gas fitting. In the smaller undertaking it means for the apprentice a journey of anything up to 20 miles or so each way twice a week. However keen he may be the apprentice must think twice.

The larger undertaking can usually afford to equip the fitting staff with some of the tools which are too expensive for the fitter himself to provide, but which are essential if the work is to be well carried out. Often a fitter has to work on premises where heating engineers have worked previously. They have put in pipe runs for hot water, &c., and being well equipped with a pipe bending machine and a portable forge, their fitters have been able to do a neat job. The poor gas fitter has none of these aids. When he asks for them he is too often told that they are not required or do not warrant the capital expenditure. What then is his position? The careless man has no qualms about using two elbows and a nipple to set a pipe back 3 in. The tidy man has either to walk to the nearest blacksmith—maybe a mile or more away —use his forge, or try setting the pipe in a gully while keeping an eye open for the local surveyor. If he tries setting the pipe in the vice on the hand cart he usually ends by partially flattening it. The whole job when finished compares unfavourably with the work done by the heating engineers.

The large undertaking employs sufficient fitters to make it worth while for a manufacturer to send a representative to give a talk or series of talks about their appliances, and they usually have a projector and can show films of various aspects of gas fitting and appliances. The smaller undertaking does not have these facilities. Having sufficient personnel, the large undertaking can employ men who specialise in one branch or other of fitting. The fitter in the small undertaking has to deal with all jobs, from main and service laying, carcassing, installation of meters, and all classes of appliances, and also complaints and maintenance.

What are we to do to improve the standard of gas fitting?

First I would suggest that where facilities exist all apprentices should take the Gas Fitting Course of the City and Guilds In this respect it would help considerably if the undertaking would bear the expense, including fares, for the student. Then, taking the course would be a condition of apprenticeship. Where there are no facilities for this, the excellent arrangement of the Gas Fitters' Classification Scheme which was introduced a year or so ago gives a useful incentive to the keen man. On that subject I would like to ask if it is sufficient for a fitter to pass an examination once and then be classed as a Grade 1 fitter for the rest of his career. Is it too much to ask that a panel of examiners from both sides of the industry should periodically—say every three years—inspect the work done on the district by Grade 1 fitters to ensure that it is up to standard? A man who takes a pride in his work would have no fears about having his work so inspected, and I think that it might encourage the lazy man to put just that little extra effort into his work to make it a first-class job, especially if he knew that failure to qualify would mean reverting to Grade 2 with a consequent reduction in his pay packet.

Every fitter should be able to have on request all the necessary tools to enable him to carry out a first-class job. Would it not be possible for an area board or a division to have a supply of tools available for use by the various undertakings? If some such arrangement could be made, the management would remove from the fitter the excuse that he could not make a first-class job because of lack of tools.

Manufacturers are always willing to send a technical representative to give a talk to fitters on various aspects connected with gas fitting. More use should be made of this source of information. Here the large undertakings can help the small ones considerably by inviting their fitting staff to attend such talks. Without their help, the fitters of the small undertaking have no opportunity of benefiting in this way, as insufficient fitters are employed to make the lecturer's attendance worth while. The showing of films is another opportunity for the large undertaking to help. I should here like to pay a personal tribute to the Colchester undertaking. Whenever this undertaking has a technical representative to give a talk or has any films to show it invites the staffs of undertakings in North East Essex. Ascot Gas Water Heaters, Ltd. have a scheme in operation for instructing fitters in the fixing and maintenance of their water heaters. Fitters can obtain first-hand knowledge of these appliances thereby, and undertakings could profitably send at least some of their fitters to these courses.

## DISCUSSION

Mr. **C. J. Barkaway** (Bury St. Edmunds) asked if the Harwich Undertaking had ever been approached by the fitters to provide a small library of books. His undertaking, not much larger than Harwich, had always provided fitters with text books. It had not proved expensive, and he felt sure the service had been beneficial.

Mr. **Waller** replied that no special arrangement had been made at Harwich.

Mr. **T. W. Benstead** (Clacton) expressed the view that a fitter with a sound training on a small works could easily become a specialist. Did the author consider that fitters' tool kits today compared favourably with those prior to the war? His experience was that the older man had the more comprehensive and expensive kit of tools, while the younger man considered that a screwdriver and one or two other tools were sufficient. In regard to a central depot of tools, he would be interested to know on what system these would be 'charged

* This paper was awarded the Prize of the Eastern Junior Gas Association for 1950. The paper was read at a meeting of the Association on January 18.

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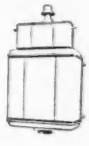

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out' to undertakings. The author mentioned that a fitter was required to do mainlaying; in his experience this was unusual.

Mr. **Waller** pointed out that the joint responsibility of gas fitters was one of the disadvantages small undertakings worked under. In Harwich, a very small staff fitters, with the assistance of labourers, had to combine mainlaying with their other duties. In regard to tools generally it was found that fitters of all ages provided an adequate kit of the smaller tools. The undertaking provided tool bags. The major difficulty was, as stated, the larger type of tool in infrequent demand. The question of use of tools from a central depot had to some extent been overcome since the grouping of undertakings. Already Harwich had taken advantage of tools from group headquarters.

Mr. **S. Halls** (Cambridge) agreed with the author regarding the City & Guilds examinations. Where facilities were not available, the Gas Fitters' Classification Scheme covered the ground. He would, however, stress the necessity of adequate tuition on the right lines, particularly in theory. From examinations, excellent men from a practical viewpoint had fallen down badly in theory. Text-books should be supplemented by someone to guide the course of study.

Mr. **L. W. Jarrett** (Cambridge) pointed out that while examination qualifications set a certain standard, continued practical experience was essential.

Mr. **L. C. Coleman** (Bury St. Edmunds) remarked that the author mentioned the possibility of a Grade A fitter becoming slack and his work suffering in consequence. Surely this was a matter for the local distribution engineer to check-up.

Mr. **Waller** felt that no fitter should require constant supervision.

Mr. **J. T. Brookes** (President, Norwich), concluding the discussion, expressed his thanks to Mr. Waller for his paper and his replies to questions. They had to realise that the fitter was the representative of the board so far as the customer was concerned. In addition to his training it was also the man's general demeanour, as he went about his work, that had to be looked after. Nationalisation of the industry gave many advantages. One could visualise a common classification of gas fitters. Whether a man came from a large undertaking or a small undertaking, they had to appreciate that with the possibility of movement between undertakings a man should leave one undertaking as a Grade 1 fitter and arrive at an even larger undertaking still as a Grade 1 man. The point Mr. Waller made regarding the better use of the more expensive type of tool was one of the advantages that should arise through the grouping of undertakings consequent on nationalisation.

Mr. **W. J. Collins Garrard** (General Manager, Ipswich Division, Eastern Gas Board) expressed his pleasure at being present and welcomed the members to Ipswich. He hoped that the paper and discussion presented had proved helpful. Mr. Garrard briefly described the grouping system of undertakings as it applied to his division. He felt certain that as the system developed help would be forthcoming to the smaller undertakings so that they, at least, could reap one of the advantages of nationalisation. Mr. Garrard congratulated Mr. Waller on his paper and had pleasure in presenting the author with the prize offered for the competition.

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*GAS QUALITY AND APPLIANCE PERFORMANCE — Continued from p. 123*

propane/air plants, especially in the smaller works, for peak load purposes. Mr. Fuidge and Mr. Forshaw had combined in attacking the variable injector; he agreed with them that it was an unjustified feature. Mr. Mills had made a comparison between the German code of practice and the North Thames Gas Board performance; the whole point was that if the North Thames standard were applied to the whole country there would be a reasonable comparison. The variations in the gas were a little less than the variations which the appliance makers were told to accommodate. As to the relationship between Wobbe index and A.T.B. number, his contention was that to change from calorific value to Wobbe index would be an advantage. There was a strong case for making that change; nevertheless, he admitted that there were several practical and legal difficulties in the way of going so far at the present time.

On the proposition of Dr. **A. E. Haffner** (North Thames Gas Board), seconded by Dr. **J. R. Dewhurst** (South Eastern Gas Board), a vote of thanks was accorded to Mr. Minchin.

## WESTERN DISTRICT DISCUSSION

Mr. **Minchin** presented the same paper at a meeting of the Southern Association of Gas Engineers and Managers (Western District) at Taunton on January 19, under the chairmanship of Mr. J. H. Cornish, Junr.

The **Chairman** said that the sooner gas quality was controlled from the larger undertakings the better, secondly the paper was a very good advertisement for continuous vertical retort practice, and thirdly he was not quite clear whether Mr. Minchin supported dilution by water gas or some other means. Personally he (the speaker) was not enthusiastic about the use of large quantities of carburetted water gas for dilution purposes.

Mr. **L. P. Ingram** (Northern and Southern Divisional Deputy General Manager, South Western Gas Board) remarked that major problems at the moment were worn-out manufacturing plant and out-of-date distribution systems where the consumption had outgrown capacity; other refinements must perforce wait until these greater problems had been cleared up. Mr. Minchin's ideas should be in the foreground, however, when considering integration and distribution networks. If Mr. Minchin had only convinced the meeting that one could not afford to lose sight of his aspect of the job while progressing with the more practical side, then his visit had not been in vain.

Mr. **H. H. Brown** (Exeter Sub-Divisional Manager) said it was obvious that proper attention should be paid to providing the consumer with a gas which would function properly in the appliance constructed for its use. He felt that there would be serious problems facing the gas engineer if he attempted control by the Wobbe index in the same way as he controlled the calorific value. At the present time, it was possible to play about with the means of production to give certain limits to the performance of the gas which had been measured in terms of A.T.B. number. If the Wobbe index was to be controlled, it would be necessary to have some form of metering in the calorimeter, which metering should incorporate a fixed orifice with arrangements whereby the specific gravity function enabled the flow of gas to be interfered with in the same way as atmospheric action on a calorimeter interfered with the waterflow. If the idea of a straight-lined calorific value was rejected, it would be found that consumers were getting more heat than they were paying for. That already happened in some undertakings where calorific value was deliberately raised as well as the specific gravity to meet special needs.

Mr. **A. C. Rea** raised the point that during the war many undertakings reduced their calorific value to obtain more cu.ft., and when the matter of levelling up calorific values was considered he felt that the Wobbe index should be given close attention.

Mr. **W. J. Baker** (Weston-super-Mare Sub-Divisional Manager) doubted whether Mr. Minchin's fine ideas would come into effect for a number of years as there were at present few undertakings in a position to meet the demand for gas of constant calorific value and a reasonably constant Wobbe index at all times of the year.

Mr. **F. W. Sansom** (Exeter) mentioned that at Exeter, some years ago, a new installation of street lamps was put in at a time when there was no A.T.B. standard, so that no control could be exercised over combustion characteristics. It was discovered that there were more breakages than normal and the manufacturers were unable to recommend any real remedy. When the A.T.B. came on the scene it was possible to control the combustion characteristics, and better results from a maintenance point of view were obtained.

Mr. **Minchin**, in a brief reply, said that, regarding practical control, the Wobbe index was easier to keep constant than the A.T.B. number. From the point of view of lack of gas-making plant one might perhaps be able to draw on other kinds of fuel resources, such as butane and propane, for peak periods.